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CRITERIA FOR THE CONTINUITY OF LINEAR FUNCTIONALS IN REAL LINEAR SPACES[1]

OTTON M. NIKODÝM
Kenyon College, Gambier, Ohio

1. INTRODUCTION

Many criteria for the continuity of linear functionals in various linear topological spaces are known, for example, in Banach spaces the Hilbert—boundedness, expressed by the formula $|U(x)| \leqslant M||x||$, $M > 0$, is equivalent to the continuity of $U(x)$.

V. L. Klee, Jr., and the author have found, independently from one another, that these criteria have a common source in some very general topological properties of the space and Klee has even disclosed that the intersection property of open sets is many times irrelevant or can be replaced by a weaker condition (see condition (S) below). The main purpose of this paper is to throw more light on this topic. We shall deal with spaces endowed with an operation invariant paratopology (i.e., Klee's (α)—space; Klee, Jr., 1951) and with a "symmetry"—condition (S') which is slightly weaker than Klee's condition (S), (see below).

It is striking how little is required to assure the continuity, and that only a small drop of a condition is sufficient for it (see Th. 8.2). This fact can be explained by the circumstance that a linear space is an abelian group, and being a group is a very strong property.

We shall give necessary and sufficient conditions for the continuity of linear functionals in spaces much more general than the linear topological spaces. These cover all known criteria in the last ones. The proofs are very simple.

As a side result we give a generalization of the known theorem by La Salle (1941) on the existence of a non-trivial linear continuous functional.

Some properties of convex sets obtained by the author in collaboration with W. D. Berg (in infinite dimensional spaces where no topology was supposed, in 1949–1951, Berg and Nikodým, 1952) have shown themselves useful in the underlying work. As the tool we use ordering limits which are more general than Moore-Smith directed set limits (Moore and Smith, 1922; Birkhoff, 1937).

2. TERMINOLOGY AND NOTATIONS

To avoid misunderstanding we give some definitions and explanation of symbols to be used.

[1]Some results of this paper were presented to the 56th Summer Meeting of the American Mathematical Society in Minneapolis, Minnesota, September 7, 1951.

By a *linear space* we understand an abelian group L with real multipliers, (see e.g., Banach, 1932). The elements of the linear space are termed *points* or *vectors*. The null-vector is denoted by θ.

By a *linear variety in* L we understand a non empty set E of vectors such that, if $x, y \in E$ and λ, μ are real numbers, then $\lambda x+\mu y \in E$. Any translation of a linear variety will be termed *flat*.

By a *hyperplane* we understand a linear variety F in L such that (1) $F \neq L$, (2) there exists a vector x_0 such that the smallest linear variety $\{F, x_0\}$ spanned by F and x_0 coincides with L. A translation of a hyperplane is termed *hyperflat*.

If G is a non empty set of vectors, λ a number, and x a vector, then $G + x$, $[\lambda G]$ denotes the set of all vectors $y + x$ [resp. λy] where $y \in G$. If G_1, G_2 are not empty sets of vectors, then $G_1 + G_2$ denotes the set of all vectors $x_1 + x_2$, where $x_1 \in G_1$ and $x_2 \in G_2$.

The empty set (or class) is denoted by Λ, the union of sets E, F is denoted by $E \cup F$, and their intersection by $E \cap F$. The symbol $E \subseteq F$ means that E is a subset of F. If $E \subseteq F$, $E \neq F$, we write $E \subset F$. The union of all sets E belonging to a not empty class K of sets denoted by $\bigcup E$, $(E \in K)$. The symbol $x \overline{\in} E$ means that x does not belong to E.

By a *convex set* we understand a set C such that if $x, y \in C$, $\lambda \geqslant 0$, $\mu \geqslant 0$, $\lambda + \mu = 1$, then $\lambda x + \mu y \in C$. A convex set may be empty. By a *convex hull* of a set G of points we understand the smallest convex set containing G.

The *linear functional in* L is a real valued function $U(x)$ defined for all $x \in L$ and satisfying the condition $U(\lambda x + \mu y) = \lambda U(x) + \mu U(y)$ for any real λ, μ and any vectors $x, y \in L$.

A linear functional is called *trivial*, if $U(x) = 0$ for all $x \in L$. By a *topology* in L we understand a class T of subsets of L satisfying the following conditions (1) $\Lambda \in T$; (2) $L \in T$; (3) if $E, F \in T$, then $E \cap F \in T$; (4) if K is not any empty class of sets of T, then

$$\bigcup E, \quad (E \in K)$$

also belongs to T. If we drop (3), we obtain a *paratopology*, (*p top.*), (Klee, 1951). The sets of T are termed (T)–*open sets*, and their complements with respect to L, (T)–*closed sets*. No separation axiom is required, neither the continuity of the vector-operations.

If $\mathbf{R}$ is a relation (Russell and Whitehead, 1910), by its *domain* we understand the set $\mathfrak{D}\mathbf{R}$ of all elements a such that there exists b with $a\,\mathbf{R}\,b$; by its range $\mathfrak{R}$ we understand the set of all elements b such as there exists a with $a\,\mathbf{R}\,b$.

A relation $\mathbf{R}$ is termed *ordering* if (1) $\mathfrak{D}\mathbf{R} = \mathfrak{R}\mathbf{R}$ and is not empty, (2) $a\,\mathbf{R}\,b$, $b\,\mathbf{R}\,c$ imply $a\,\mathbf{R}\,c$, (3) if $a \in \mathfrak{D}\mathbf{R}$, then $a\,\mathbf{R}\,a$, (4) $a\,\mathbf{R}\,b$, $b\,\mathbf{R}\,a$ is equivalent to $a = b$ for any $a, b \in \mathfrak{D}\mathbf{R}$.

A function $f(a)$ or $\{f_a\}$, defined for all $a \in \mathfrak{D}\mathbf{S}$ (where $\mathbf{S}$ is an ordering) is termed $\mathbf{S}$ – *sequence*.

If the range of an $\mathbf{S}$-sequence belongs to a set provided with a p. top., we say that $\{f_a\}$ *tends to* g if for every open set α, containing g, there exists $a_0 \in \mathfrak{D}\,\mathbf{S}$ such that for every a with $a_0\,\mathbf{S}\,a$, we have $f_a \in \alpha$. We write $f_a \to g$. We call g $\mathbf{S}$-*limit*. Notice that g may be not unique.

If L is a linear space provided with a p. top. and G is a set of points in L, than by the *closure* $\bar{G}$ of G, we understand the set of all limits of all **S**-sequences $\{x_a\}$, for all orderings **S**, $x_a \in G$. A real valued function $\Phi(x)$ defined on L is said to be *continuous at* x_0 with respect to (T) if for every $\epsilon > 0$ there exists a (T)–open set U with $x_0 \in U$ such that for every $x \in U$ we have

$$|\Phi(x) - \Phi(x_0)| < \epsilon.$$

A necessary and sufficient condition for the continuity of Φ at x_0 is that for every ordering sequence $\{x_a\}$ we have $\Phi(x_a) \to \Phi(x_0)$.

For a function $\Phi(x)$ defined on L with a p. top. (T) the following are equivalent: (1) $\Phi(x)$ is continuous at each $x_0 \in L$, (2) for every real λ and μ the set $x \mid \lambda < f(x) < \mu$ is (T)-open.

3. SOME PROPERTIES OF LINEAR FUNCTIONALS

Let $f(x)$ be a linear functional in L, and α a real number. We define

$$E_\alpha = \{x | f(x) = \alpha\}.$$

We easily see that $E_\alpha = E_0 + x_\alpha$, where x_α is any point of E_α.

If $\alpha \neq \beta$, then $E_\alpha \cap E_\beta = \Lambda$. We have

$$L = \bigcup E_\alpha, \ (-\infty < \alpha < +\infty).$$

If $f(x)$ is not trivial, then E_α is a hyperflat. If L_1 is a hyperplane, $x_0 \bar{\in} L - L_1$, $s \neq 0$, then there exists a unique linear functional $f(x)$ such that

$$f(x_0) = s, \ E_0 = L_1.$$

Proof. Since x_0 is independent of L_1, any vector $x \in L$ possesses a unique representation

$$x = y + \lambda x_0 \text{ where } y \in L_1.$$

Put

$$f(x) = \lambda s.$$

One proves readily that $f(x)$ is a linear functional having the required properties. The uniqueness is obvious.

4. SPACES WITH THE TRANSLATION, MULTIPLICATION AND (S') PROPERTY

Let L be a linear space endowed with a p. top. (T). We say that (T) has the *translation property*, if for every (T)–open set E and for every vector x_0 the translation $E + x_0$ is also (T)–open. We say that (T) has the *multiplication property*, if for every $\lambda \neq 0$ and every (T)–open set, the set $\lambda \cdot E$ is also (T)–open. If (T) has these two properties, and **R** is an ordering, we have:

(1) if $x_\alpha \to x$, then $x_\alpha + y \to x + y$;

(2) if $x_\alpha \to x$, then $\lambda x_\alpha \to \lambda x$ for every real λ.

Remark. It may happen that $x_\alpha \to x_0$, $y_\alpha \to y_0$, but $x_\alpha + y_\alpha$ may not tend to $x_0 + y_0$. Similarly it may happen that $x_\alpha \to x_0$, $\lambda_\alpha \to \lambda_0$, but $\lambda_\alpha x_\alpha$ may not tend to $\lambda_0 x_0$.

4. Theorem. If (1) L is a linear space,

(2) (T) a p. top. on it possessing the translation and multiplication property,

(3) $f(x)$ a linear functional on L,

(4) $x_0 \in L$,

(5) $f(x)$ is (T)–continuous at x_0,

then $f(x)$ is (T)–continuous everywhere in L.

Proof. Let $x_a \to y$. We have $x_a - y + x_o \to x_o$, hence

$$f(x_a - y + x_o) \to f(x_o), \text{ and then}$$

$$f(x_a) - f(y) \to 0, \text{ which completes the proof.}$$

Thus the linear functional is either everywhere continuous or everywhere discontinuous.

Let us remark that the space with a p. top. satisfying these conditions of operation-invariance, coincides with the Klee's (α)-space characterized by the condition that $f(x) = y + rx$, where x is a variable vector, is continuous for every vector y and every real number r.

We say that a p. top. (T) on L has the *property* (S'), if $G \in T$, $\theta \in G$ imply the existence of G' such that $\theta \in G' \in T$, $G' \subseteq G \cap (-I)\, G$. This condition is slightly more general that the Klee's condition (S) stating that if $\theta \in G \in T$, then $G \cap (-I)\, G \in T$.

5. A CRITERION FOR THE CONTINUITY OF LINEAR FUNCTIONALS

We shall prove the theorem:

If (1) L is a linear space,

(2) (T) a p. top. on L possessing the translation and multiplication property,

(3) $f(x)$ a linear non-trivial functional on L, $M_o = \{x \mid f(x) = 0\}$,

then the following are equivalent:

I. $f(x)$ is (T)–continuous,

II. There exists an open set $G \neq \Lambda$ contained in a strip parallel to M_o.

Proof. Suppose I. The set $\{x \mid -1 < f(x) < 1\}$ is open and is a strip parallel to M_o, so II follows.

Suppose II. Let $G \neq \Lambda$ be an open set in the strip $\langle M_1, M_2 \rangle$ in which the boundary-hyperflats M_1, M_2 are different, parallel to M_o, and included in $\langle M_1, M_2 \rangle$. The set $G_1 = M_o + G - x_o$, where $x_o \in G$, is open, for it is the union of translations of G. It is also the union of some hyperflats parallel to M_o. We have $\theta \in G_1$. It follows that $G_2 = \bigcup \lambda G_1$, $(0 < \lambda \leqslant 1)$, is a strip parallel to M_o, and then

$$G_3 = \bigcup (1 - \tfrac{1}{n})\, G_2, \ (n = 1, 2, \ldots),$$

is so. G_3 is also parallel to M_o. By a suitable translation G_3 can be transformed into another strip G_4 with $\theta \in G_4 = (-1)G_4$. This strip does not contain its boundary which is composed of two hyperflats, M_1', M_2' parallel to M_o, and is a (T)–open set. Hence the linear functional $g(x)$, defined by putting $g(x) = 1$ for $x \in M_1$, is (T)–continuous. Indeed $k.G_4 + x_1$ where $k > 0$, and x_1 is any vector, is (T)–open so the inverse image $g^{-1}(\alpha, \beta)$ is an open set for any α, β where $\alpha < \beta$.

We have $M_o = \{x \mid g(x) = 0\}$ and then $f(x) = \lambda . g(x)$ for a suitable constant, and consequently $f(x)$ is (T)–continuous.

The above theorem implies the following one:

5.1. Theorem. If L is a linear space provided with a p. top (T) having the translation, multiplication and (S') property, then a necessary and sufficient condition that a linear functional on L be (T)–continuous is that there exists

at least one (T)–open set $G \neq \Lambda$ on which $f(x)$ is bounded from above (from below).

Since every linear topological space (see Kolmogoroff 1934, and v. Neumann 1935) has the translation, multiplication and (S') property, the criterion worded in theorem 5.1, applies to all linear topological spaces.

6. GENERALIZATION OF A THEOREM BY LA SALLE

The obtained very general theorem allows us to generalize the following by La Salle (1941); (concerning examples of lin. pop. spaces where every continuous linear functional is trivial, see Nikodým, 1931, and Day, 1940).

If L is a linear topological space then the following are equivalent:

I. There exists in L at least one linear continuous functional not identically equal O;

II. There exists in L at least one not empty open convex set which does not coincide with L.

We first prove the following Klee's lemma:

6.1. If (1) L is a linear space with a p. top (T) satisfying the translation and multiplication condition,

(2) G is a (T)–open set of points,

then the convex hull of G is also a (T)–open set.

Proof. Let F be the convex hull of G. We easily prove (Berg and Nikodým, 1952), that

$$F = \bigcup \langle x_1, x_2, \ldots, x_n \rangle \ (n = 1, 2, \ldots; x_1, x_2, \ldots, x_n \in G),$$

where $\langle x_1 \ldots, x_n \rangle$ is the set of all points

$$y = \Sigma \ \alpha_{i=1}^{n} x_i \text{ where } \alpha \geqslant 0, \ \Sigma_{i=1}^{n} \alpha_i = 1.$$

Let $x \in F$. We have

$$x \in \alpha_1 G + \alpha_2 G + \ldots + \alpha_m G \subseteq F \text{ for some } m \text{ and } \alpha_i, \text{ for which } \alpha_i > 0,$$
$$\alpha_1 + \ldots + \alpha_m = 1.$$

By the multiplication property, $\alpha_i G$ is open. Now we notice that, if E, F are open, so is $E + F$. Indeed, $E + F = \bigcup(E + y)$, $(y \in F)$, and by the translation property $E + y$ is also open. Having this, we prove, by induction, that $\alpha_i G + \ldots + \alpha_m G$ is open, which completes the proof.

6.2. Suppose there exists a (T)–open set $G \neq \Lambda$ contained in a halfspace N whose boundary, which is a hyperflat, be denoted by ρ.

Let $\rho_0 = \rho + (-z_0)$, where $z_0 \in$ p.

ρ_0 is a hyperplane. Let $y_0 \in N$ but $y_0 \in \rho$.

The vector $y_0 - z_0$ is independent of ρ_0. Let P be the set of all vectors

$$(y_0 - z_0) \cdot \lambda + y_1 \text{ where } \lambda \geqslant 0, \ y_1 \in \rho_0.$$

P is a halfspace whose boundary is ρ_0. The set

$$N_0 = \bigcup (G + x), (x \in F)$$

is a halfspace containing G and a (T)–open set too.

Let $u_0 \in N_0$, $u_0 \in \rho_0$. There exists a linear functional $f(x)$ on L such that $f(x) = 0$ for $x \in \rho_0$ and $f(u_0) = 1$. This functional is bounded from above or from below on the open set N_0, hence, by theorem 5.1., it is a (T)–continuous functional on L.

Now suppose that there exists a linear continuous functional $f(x)$ with $f(x) \neq 0$. The set $\{x|f(x) > 0\}$ is a (T)–open set and a halfspace.

If we take account of the lemma, we can state the following:

6.3. Theorem. If L is a linear space provided with a p. top. (T) having the translation, multiplication and (S') property, then the following are equivalent.

I. There exists on L a (T)–continuous linear functional not identically equal 0;

II. There exists a not empty (T)–open set contained in a half-space;

III. There exists a non empty (T)–open convex set contained in a halfspace.

6.4. The theorem of La Salle is covered in this theorem. Indeed his theorem deals with linear topological spaces, and they all possess the translation, multiplication and (S') property. A not empty open set contains necessarily a linearly inner point, i.e., a point x_0 such that every straight line passing through it contains an open segment which contains x_0. Consequently (Berg and Nikodým, 1952) every convex not empty open set is a convex body. If a convex body does not coincide with the whole space, it possesses at least one boundary point y_0.

Now Dieudonné (1941) has proved that there exists a hyperflat ρ passing through y_0 and such that the convex body is contained in one of the two halfspaces determined by ρ. Hence, if there exists in L at least one open convex set $\neq \Lambda$ not identical with whole space, then there exists a linear continuous not trivial functional. The converse theorem is obvious.

7. SPACES WITH THE TRANSLATION, MULTIPLICATION AND STAR-PROPERTIES

We start with an auxiliary theorem.

Theorem. If (1) L is a linear space provided with a p. top. (T) having the translation, multiplication and (S')-property,

(2) $f(x)$ is a (T)–discontinuous linear functional on L,

(3) $\theta \in G \in T$, then there exists an stream-sequence $x_\alpha \to \theta$, such that $f(x_\alpha) \to +\infty$, $x_\alpha \in G$.

Proof. Define the relation $\mathbf{R}$ (Whitehead and Russell, 1910), whose field is the class of all (T)–open sets, containing θ and $\in G$, in the following way:

$$U_1 \mathbf{R} U_2 \ . = . \ U_2 \subseteq U_1.$$

$\mathbf{R}$ is an ordering.

Let $\mathbf{S}$ be a relation whose field is composed of all ordered couples (U, p) where $U \in \mathbb{B}\mathbf{R}$ and $p > 1$. We define

$$(U_1, p_1)\ \mathbf{S}\ (U_2, p_2) \text{ by } U_1 \mathbf{R} U_2,\ p_1 \leqslant p_2.$$

$\mathbf{S}$ is also an ordering. We have supposed that $f(x)$ is discontinuous. Hence, by theorem 5.1., on each $U \in \mathbb{B}\mathbf{R}$, the functional $f(x)$ is not bounded from above. Hence for every U and $p > 1$ there exists $x_{U,\,p}$ with $f(x_{U,\,p}) \geqslant p$, $x_{U,\,p} \in U$.

We see that the $\mathbf{S}$–sequence $\{x_{U,\,p}\}$ tends to θ. But we also see that $f(x_{U,\,p}) \to +\infty$. This completes the proof. The above theorem yields another condition for continuity of a linear functional, easy to word.

7.1. Let E be a set of points in L and x_0 a point $\in E$. We say that E is *starred at* x_0, if for every $x \in E$, $x \neq x_0$, the closed segment $\langle x_0, x\rangle$ belongs to E.

We say that a p. top. (T) *has the star-property*, if for every (T)–open set G containing x_0 there exists a (T)–open set G_1 starred at x_0 such that $G_1 \subseteq G$.

It is not in general true that a space L with a Hansdorff topology, having the translation and multiplication property, has also the star property. Later on we shall have an example showing this. Following the lines of the construction of this example, we can even have an example on the two-dimensional plane.

8. ANOTHER CRITERION FOR THE CONTINUITY OF LINEAR FUNCTIONALS

The above auxiliary theorem yields the

Theorem. If (1) L is a linear space provided with a p. top. (T) possessing the translation, multiplication, (S') and star property,

(2) $f(x)$ is a linear discontinuous functional on L,

(3) $G \neq \Lambda$ is a (T)–open set,

(4) a a number,

then there exists in G a point x_0 such that $f(x_0) = a$.

Proof. Suppose that

$$\theta \in G \qquad (1)$$

and take $a > 0$.

Since (T) has the star property, we can find an open set G_1 starred at θ with $G_1 \subseteq G$.

Since $f(x)$ is discontinuous, there exists an ordering $\mathbf{R}$ and an $\mathbf{R}$-sequence $\{x_\alpha\}$ with $x_\alpha \to \theta$, $x_\alpha \in G_1$ and $f(x_\alpha) \to +\infty$, (therom 7).

There exists γ such that, if $\gamma\, \mathbf{R}\, \alpha$, we have

$$f(x_\alpha) \geqslant a.$$

We have

$$x_\gamma \in G_1, f(x_\gamma) \geqslant a > 0.$$

Put

$$y = a \cdot \frac{x_\gamma}{f(x_\gamma)}.$$

We have $y \in G_1$, because $0 < \dfrac{a}{f(x_\gamma)} \leqslant 1$,

and we have

$$f(y) = \frac{a}{f(x_\gamma)} \cdot f(x_\gamma) = a,\ y \in G.$$

Thus, if $a > 0$, then there exists, in G, a point at which $f(x)$ admits the value a.

Let $a < 0$. The functional $g(x) = -f(x)$ is also discontinuous; hence there is, in G, a point z at which $g(z) = -a$. Hence $f(z) = a$.

Since $f(\theta) = 0$, $\theta \in G$, we conclude that for every a there exists $y \in G$ with $f(y) = a$.

Now let G be an arbitrary not empty (T)–open set. Let $x_0 \in G$. Put

$$G_1 = G + (-x_0).$$

Since G_1 is an open set containing θ, there exists y with $y \in G_1, f(y) = a - f(x_0)$.

Putting $z = y + x_0$,

we have

$$f(z) = f(y) + f(x_0) = a, \text{ and } z \in G_1 + x_0 = G.$$

The theorem is proved.

8.2. As a consequence we have the

Theorem. If (1) L is a linear space provided with a p. top. (T) possessing the translation, multiplication, (S') and star properties,

(2) $f(x)$ is a linear functional on L,

the following are equivalent:

I. $f(x)$ is (T)—continuous;

II. There exists a number a and a (T)–open not empty set G such that $f(x)$ does not admit the value of a on G.

8.3. Let us remark that if we drop the star property, the thesis may be not true.

E.g. Let L be a real infinite-dimensional Hilbert space with usual metric topology (T) given by the norm. The open unit sphere S:

$$||x|| < 1$$

is a convex body in L.

Now the following theorem is true (Berg and Nikodým, 1952): If E is a convex body in a linear space, then there exists a hyperplane ρ such that every hyperflat obtained by a translation of ρ has at least one common point with E.

Let ρ_0 be such a hyperplane in L for the convex body S. Take a vector ξ independent of ρ_0, and put

$$\rho_1 = \rho_0 + \xi.$$

Let $f(x)$ be the linear functional defined on L by the conditions

$$f(x) = 0 \text{ on } \rho_0,\ f(\xi) = 1.$$

Consider the set

$$A = \bigcup_{k=1}^{\infty} \frac{1}{k}\, \rho_1,$$

and take the class K of all sets

(1) $\ldots . G - \bigcup_{p=1}^{n} (\alpha_p A + x_p)$, $(n = 1, 2, \ldots .)$, where G is a (T)–open set, x_p a vector and α_p a real number $\neq 0$. Denote by (T') the smallest topology containing K. It possesses the translation and multiplication property and is a Hausdorff topology.

The functional $f(x)$ is (T')–discontinuous.

Indeed let $G' \neq \Lambda$ be a (T')–open set. There exists $G_1 \in K$ with $G_1 \neq \Lambda$ and $G_1 \subseteq G'$. G_1 has the form (1) where $G \in T$, $G \neq \Lambda$. Since G is a (T)–open set, $\neq \Lambda$, there exists $\beta > 0$ and y_0 such that $S_1 = y_0 + \beta S \subseteq G$. Since every hyperflat parallel to δ_0 cuts S, every hyperflat parallal to δ_0 also cuts S_1. As there is an at most denumerable number of hyperflats, $\delta_1, \delta_2, \ldots .$ parallel to δ_0 and such that

$$G_1 = G - \bigcup_m \delta_m,$$

it follows that all hyperflats parallel to δ_0 cut G', excepting perhaps a denumerable number of them. Hence $f(x)$ is neither bounded from above nor from below on G_1, and then, by theorem 5.1, $f(x)$ is (T')–discontinuous.

Nevertheless $f(x)$ does not admit the value $\frac{1}{2}$ on the (T')–open set $S - A$.

8.4. As a consequence we have the following theorem:

Theorem. If (1) L is a linear space provided with a p. top. (T) having the translation, multiplication, (S') and the star property,

(2) $f(x)$ is a linear functional on L,

then the following are equivalent:

I. $f(x)$ is (T)—continuous,

II. The set $\{x|f(x) = O\}$ is (T)—closed.

Proof. II follows easily from I. Put

$$E_o = \{x|f(x) = O\}.$$

The set $L - E_o$ is (T)–open, and on it $f(x)$ does not admit the value O. Hence by theorem 8.2, $f(x)$ is (T)–continuous.

8.5. Every linear topological space (Wehausen, 1938, v. Neumann, 1935) possesses not only the translation and the multiplication property, but it also has the star property (Hyers, 1939). Consequently the theorems 8.2 and 8.4 hold for them, and then they hold for all Fr. Riesz-Banach spaces (Banach, 1932) and for the F—spaces (Banach, 1932).

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The Ohio Journal of Science award for excellence in research will be given this year to a member of the Zoology Section of The Ohio Academy of Science. Information about eligibility and rules may be found on page 216 of the July, 1952, number of the Journal.

A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART. AVES XVI. CHARADRIIFORMES, PART 2[1]

FRED H. GLENNY

Department of Zoology and Entomology, The Ohio State University, Columbus 10

Recent continued studies on the arteries in the neck and thorax of seven species of Charadriiformes were made possible by the loan of alcoholic specimens from the anatomical collections of the Chicago Natural History Museum and the U. S. National Museum.

The writer wishes to express his gratitude to Mr. Dwight D. Davis, Dr. Herbert Friedmann, and Dr. Alexander Wetmore for their help in making these materials available for this study.

Except where otherwise indicated, single specimens were dissected and diagrams of the arterial arrangement-patterns prepared.

MATERIALS

Suborder CHARADRII

Family **Charadriidae**

Belonopterus chilensis lampronotus (Wagler) (CNHM #106097).

Suborder LARI

Family **Laridae**

Rissa tridactyla pollicaris Ridgway (USNM #81523).

Suborder ALCAE

Family **Alcidae**

Uria aalge inornata Salomonsen (USNM #81379).

Synthliborhamphus antiquus (Gmelin) (USNM Nos. 81608, 81707, 18317 to 18321 incl.)

Synthliborhampus wumizusume (Temminck) (USNM #87266 & 87267).

Aethia cristatella (Pallas) (USNM #18313).

Cyclorrhynchus psittacula (Pallas) (USNM #18314 & 18315).

OBSERVATIONS

The arterial arrangement-pattern of *Belonopterus chilensis lampronotus* is almost identical with that of *Charadrius vociferus vociferus* (Oxyechus v. vociferus) (Glenny, 1947) except that the origin of the sterno-tracheal artery could be determined in *Belonopterus* where it arises as a branch of the coracoid major artery; no vestigeal right ligamentum botalli could be accurately located; origin of the left vertebral artery was separate from, but close to the base of, the superficial cervical artery (comes nervi vagi) which gives rise to an accessory oesophageal artery.

Rissa tridactyla pollicaris is similar to *Larus argentatus* (Glenny, 1947) in basic arrangement, but differs in the following respects: the right ligamentum botalli is short, the proximal portion becoming completely atrophied; the sterno-tracheal artery arises as a branch of the coracoid major artery; the superficial cervical arteries (comes nervi vagi) arise separately (not in common with the vertebrals) from the common carotid arteries.

Uria aalge inornata follows the basic ordinal pattern of the Charadriiformes (Glenny, 1948). The superficial cervical and vertebral arteries arise separately

[1]Contributions from the Blue Sea Lake Biological Laboratory, Messines, P. Q., Canada.

from the common carotid arteries. An accessory oesophageal artery arises as a branch of the left common carotid. The ligamentum aortae is present, although the right ligamentum botalli appears to be entirely lacking.

Except for the accessory oesophageal artery, which appears to be absent, the arrangement-pattern of *Synthliborhamphus wumizusume* is like that of *Uria aalge inornata* (above).

Basically, *Synthliborhamphus antiquus* is like that of *S. wumizusume* and *Uria aalge inornata*, except that in one type (bicarotidinae) (USNM #18317 & 18318) an accessory superficial cervical artery was observed to arise in common with the left vertebral artery (Glenny, 1952). The ligamentum botalli appeared to be completely lacking in this species. A second type of arrangement (laevocarotidinae) (fig. 2, Glenny, 1952) was observed in five specimens (USNM #s 81608, 81707, 18319–18321). In these specimens, the basic ordinal pattern—as seen in *S. wumizusume*—was characteristic except for the very singular fact that the right internal carotid trunk was lacking. The embryonic connection of the right third aortic arch with the anterior dorsal radix of the right side had become lost, and the ventral portion of this arch became functionally modified as an accessory vertebral artery—passing dorsally and anteriorly just anterior to the normal vertebral artery (in the region of the brachial plexus). Such a functional modification differs somewhat from that, of this same structure, in *Tockus alboterminatus alboterminatus* (Buttikofer) (*Lophoceros melanoleucos alboterminatus*) (Glenny, 1943) wherein the vessel in question comes to serve the ventro-cervical muscles at the base of the hypapophysial canal.

Cyclorrhynchus psittacula differs from the Alcidae included in this study in that the vertebral and superficial cervical arteries have a common origin from the common carotid artery, an accessory oesophageal artery arises as a branch of the left common carotid, a coracoid minor artery is found in addition to and just lateral to the coracoid major artery, only the proximal portion of the right ligamentum botalli could be found as it maintains its proximal connection with the pulmonary artery, and finally the left radix aortae was found to be patent and functional (several small twigs were observed branching from the radix in much the same manner as was reported in *Ceryle alcyon*) (Glenny, 1939, 1943) with a terminal ligamentous portion attached to the left pulmonary artery.

The arterial arrangement-pattern in *Aethia cristatella* is very similar to that of *Cyclorrhynchus psittacula* except that the common origin of the superficial cervical and vertebral arteries is not so pronounced or may be separate, and the ligamentum botalli is lacking. Both the coracoid major and minor arteries were present.

DISCUSSION

While the Charadriiformes are fundamentally bicarotid as pointed out by Garrod (1873), Beddard (1898), and Glenny (1947, 1948), it may be observed that this condition may be altered in cases such as has been observed in *Synthliborhamphus antiquus*.

Bremer (1928) has shown that the normal loss of the left fourth aortic arch in the chick is due chiefly to mechanical forces. It may well be reasoned that some of the functional modifications, along with the atrophy or complete loss of certain of the embryonic vessels or their derivatives may be due in large part to some, as yet unexplained, mechanical force or forces. These may be inherent characters which have become reasonably well established within a strain which might develop under conditions of "breeding-site isolation" such as may occur in the Aleutians and other islands along the coast of Alaska. Such may be the case in the instance of *Synthliborhamphus antiquus* as reported in this paper.

In general, the Alcidae show a high degree of similarity in their arterial arrangement-patterns. Furthermore, while some differences are found in the

several suborders and families, the basic ordinal arrangement holds, except in very special instances.

Atrophic gradients appear to function at different levels in different species, and the level of atrophy of any vessel is not to be regarded as characteristic of either a suborder or family, but rather more as a specific characteristic.

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Scientific Russian Reader. *Noah D. Gershevsky.* Pitman Publishing Corporation. New York. First Edition. 1948. xxii+253 pp. $4.00.

This text is important because it represents the first serious post war effort in this country to produce a Scientific Russian Reader. As Professor Gershevsky very aptly points out, the importance of Russian Science is increasing in all fields and thus the desirability for American Men of Science to become familiar with the Russian language also has increased greatly.

Previous publications on Scientific Russian have been, for the most part, the work of Russian language students who became interested in Scientific Russian as a sideline. This text is different. As an engineer, Professor Gershevsky has a good understanding of the needs of the technical man in his use of a foreign language.

The *Reader* presupposes the equivalent of one term of instruction in Russian. The exercises cover graded topics in Chemistry (28 sections) and Physics (85 sections) taken directly from Russian publications written by Russians with no modifications. Thus the material contains the same construction and idiom as the original Russian publications one might desire to consult. Notes by the author on the difficult and idiomatic passages in each lesson follow the Russian text material. A short vocabulary section giving the new technical terms in each exercise is also included. The general vocabulary section of the book appears quite complete, although there are some omissions; furthermore, the print is so small that it would present difficulties for anyone not familiar with the cyrillic alphabet.

Each lesson in the book covers essentially one topic. The index contains the lesson headings in both Russian and English. Thus the student may quickly choose the topics most interesting or most vital to him at the time. In so doing he would lose the benefit of the graded difficulty in the selections as arranged.

Only the fields of Chemistry and Physics are covered in this text for the following reasons:

1. A text covering all fields would involve a very wide selection of topics, many of which would not be of general interest. An unwieldy and expensive book would result.
2. Chemistry and Physics are basic to all fields of science and engineering and can serve as good springboards for other fields.

Professor Gershevsky plans special readers for other fields at a later date. These will be awaited with much interest.

E. S. Foster, Jr.

CLASS STRUCTURE AND ACCULTURATION IN HAITI[1]

ERIKA E. BOURGUIGNON

Department of Sociology, The Ohio State University, Columbus 10

Haitian culture today shows a variety of patterns of behavior and attitudes resulting from the historical processes that have marked its development. These have theoretical interest, not only for our understanding of Haitian culture, but may also have a bearing on the analysis of other Afroamerican areas, as well as on the study of processes of acculturation in general.

It has been attempted to break down the processes of acculturation and culture change into a series of concepts, designed for purposes of analytic discussion. The terms used—retention, reinterpretation and syncretism—were coined by Herskovits (1945). Retention refers to the integral maintenance of old cultural material. Reinterpretation refers to the maintenance of such material with change of use, meaning, form and/or function. Syncretism refers to the amalgamation of old and new cultural materials to form an essentially new series of cultural elements: traits, complexes, patterns.

The purpose of this paper is to apply these concepts to acculturation as exemplified in contemporary Haiti, with particular attention to the stratification of Haitian society. What sort of class structure do we find in present-day Haiti? How does this class structure affect the manner and extent to which the members of the various classes are exposed to culture contact? Is the operation of the acculturational processes uniform among the classes? Are the three processes of retention, reinterpretation and syncretism sufficient to deal with all observational materials referring to culture contact in Haiti, or are there other concepts which seem to be called for by the data?

While no exhaustive demonstration can be attempted in the present paper, some working hypotheses may be suggested.

Haiti's population was originally derived from the West Coast of Africa and from France. As a consequence of a successful revolution in 1804, the country was isolated from the outside world for approximately one hundred years, and during that period of isolation a stable cultural amalgam was formed. However, prior to this period of independence and isolation, the basic social structure had already been set during the French colonial era, which came to an end in 1804. Although, with the revolution, slavery was abolished and the colonists were driven out, the resulting changes did not so much modify the structure of the society, as its personnel. The westernized mulattoes moved up one step in the social ladder and took over the dominant positions. The gap between this group—the contemporary élite, comprising about 3 per cent of the population—and the large masses of the people, is as great as that between the European masters and their African slaves ever was. These divisions, which we might refer to as "groupings of classes," affect all aspects of contemporary Haitian life. The differences between these groupings should be thought of primarily as differences in culture, and above all in goal orientation, rather than as differences in skin color, although, on the whole, such differences do exist.

It is within this complex population that we wish to observe the operation of the acculturative processes mentioned earlier. Here retentions refer to African

[1]This paper was read at the Sixtieth Annual Meeting of the Ohio Academy of Science, Section K, held at Miami University, April 6, 1951. The material on which this paper is based was gathered during a field trip to Haiti, during 1947–8. This trip was made possible by the Carnegie Corporation of New York and the Graduate School of Northwestern University.

materials maintained unchanged in the contemporary culture of Haiti. Retentions were found only among the masses, the physical and spiritual heirs of the Africans brought to Haiti during the period of slavery. Pure retentions are found in such aspects of culture as motor behavior, rhythm, choreography, music, grammar, elements of technology, elements of religion and food preferences. With the exception of food preferences and certain elements of religion, motor behavior may be suggested to underlie all the other retained aspects of culture. The retentions appear to operate primarily on an unconsciously patterned, unverbalized level. Their persistent endurance may perhaps be best accounted for by the observation, that these elements of culture are acquired in the earliest experiences of the child. It must also be noted that these particular areas of culture were not, and are not now, exposed to considerable acculturative pressures, if any.

Reinterpretation and syncretism were similarly found to be primarily characteristic of the masses. These processes appear to require the ability of a given cultural element to be verbalized, to be, in Sapir's (1916, p. 415) phrase "conceptually detachable." In the case of reinterpretation and syncretism, new elements are taken over from the culture with which contact is established, and are integrated into the predominantly African way of life of the masses. Reinterpretation and syncretism are made possible by the receptivity that essentially marks Haitian culture. By receptivity here is meant the capacity for cultural elaboration and invention as well as for the acceptance of foreign materials. This is true especially in the field of religion, but also elsewhere. In the area of religion, syncretisms have frequently been pointed out, for it is here that they are the most striking. It must be stressed that the African elements of the population came from a variety of different tribes. Thus we note that in the religious patterns of *vodun*—the name under which Haitian popular religion is best known—we find contractions and inner syncretisms of a variety of elements from African sources, as well as European ones. Thus the following syncretistic possibilities exist: between several elements of the same African region; between several elements of different African regions; between African and European elements. In the first case, two distinct supernatural entities of the same African region become one, such as Ogun and Shango, both of Yoruba origin, become Ogun Shango. This new entity is in its turn syncretized with one of European origin, St. James the Elder. Other types of Afro-Catholic syncretism occur in the course of ritual, in which Catholic prayers precede essentially African services; the sign of the cross, baptism, and other Catholic elements similarly have been integrated into *vodun* worship. In general it may be suggested that reinterpretation and syncretism are characteristic of an old and settled acculturation, outcome of a period of culture contact that took place in the past.

With reference to the ongoing culture contact, however, another process has been observed, which we may call compartmentalization. This process appears to characterize individuals of all classes who are currently exposed to acculturative pressures. Compartmentalization represents still another mode of dealing with materials derived from different cultural contexts. It is akin to syncretism in that it involves the element of simultaneity. In compartmentalization, as in syncretism, two patterns of behavior are preserved. While in syncretism the two patterns are complementary in the same situation, in compartmentalization the two patterns are simply relegated to different spheres of life, and not integrated into a total structuring of behavior. This separations of patterns is found, for instance, among the peasants of Furcy. In the spring of 1948, the government attempted to introduce into this area the planting of potatoes, and to stimulate this development, seed, fertilizer and labor were to be provided for the peasants on a sharecropping basis. The peasants were willing enough to accept the governmental offers, but the potatoes were considered exclusively as a market crop. For their own consumption, the peasants continued to raise corn. When

asked whether fertilizer was used for the growing of corn, the answer was prompt: fertilizer goes with potatoes, which are to be sold. Corn is grown in the age old fashion, to be eaten by the peasants, and no fertilizer is necessary. The same type of adjustment is also found in the field of religion, as for instance in the case of one Protestant evangelist. This man considered the ability of certain individuals to transform men into animals to be a pecularly Haitian talent. He did not consider such belief to have any relation to *vodun;* he had rejected all he considered *vodun* belief and all participation in *vodun* activity in order to become a Protestant. While rejecting *vodun* participation, and accepting Protestantism in its place, there was no realization on the part of this man to what extent his world view was informed by *vodun* belief. Compartmentalization makes it possible to accept simultaneously contradictory patterns of belief and behavior. This contradictory co-existence is made possible by the fact that the territory each of these patterns covers is walled off from the other, so that no transfer, no conflict and no ambivalence result. On the whole, we find that most instances of compartmentalization occur largely among people of the upward mobile groups of the masses and the lower rungs of the élite. They belong to those areas where change is occurring, either through adoption or through imposition. Although a new element may be introduced or an old one discarded, this is not farreaching enough to demand a reorganization of the total patterns of experience. Nor is the new element akin enough to the old culture to be integrated through the mechanisms of reinterpretation and syncretism.

Among the élite and the upward mobile members of the masses, we find a characteristic that has been called "socialized ambivalence" (Herskovits, 1937, p. 295). This is a patterning of emotionally contradictory attitudes, rather than a patterning of specific cultural content. While the cultural content to which socialized ambivalence refers is as a rule verbalized, the presence of ambivalence is not a conscious matter. As the term ambivalence indicates, we have here a simultaneous attraction and hostility toward the same object, and we find that it characterizes individuals who are attracted to opposite ways of life. The presence of socialized ambivalence in the élite may be understood in view of the observation that the life of the élite individuals involves strong elements of discontinuity, especially with reference to *vodun* belief. That is to say, the élite child in its early years is reared largely by members of the masses, who teach the child the créole language, and who use elements of *vodun*-related folklore to teach and to control the child. These early teachings are strongly contradicted as the child enters school, and comes, especially with adolescence, increasingly under western influence. In Benedict's (1938) term, the socialization of the élite child is "discontinuous" while no such discontinuities exist for the masses. Among the élite, ambivalence is present with reference to Haitian tradition, Haiti's African past, and the outside world, toward France and America, toward religion and toward sex, toward birth control and standards of beauty, toward the masses and toward one's own self, as well as many other areas of life. The élite are aware of their own cultural background to a degree impossible for the masses. They are exposed to the culture of the masses from the day they are born, for they are reared largely by servants, and créole is the first language they learn. They are proud of their country's tradition and they identify with France; they hate the United States for its occupation of Haiti and its Jim Crow attitude, but they are attracted and fascinated by the United States. They are fascinated by Africa, and often romanticise their African past, but they reject all identification with Negroes. Whereas syncretism helps to present a complete picture of the universe, a harmonious world view, ambivalence is essentially disruptive, not only of a harmonious world view, but also of a successful self-identification. There is, it must be noted, an important distinction to be made, between socialized ambivalence and the other acculturative processes mentioned before. Whereas retention, reinterpreta-

tion, syncretism, and compartmentalization involve primarily objects and behavior patterns, socialized ambivalence involves primarily attitudes, whether expressed verbally or in overt actions; not only that, but that which is here patterned is not the actual content of the attitudes, which will vary according to the occasion and the individual. The patterned, socialized aspect is the quality of ambivalence itself, ambivalence as a character trait. This character trait, in turn, forms part of the total psychological structure, typical of the Haitian élite. Retention, reinterpretation, syncretism and compartmentalization are essentially psychocultural processes of acculturation, which make it possible for a culture group to deal with new experiences arising out of the contact situation, while maintaining an essentially integrated view of the world. In the case of socialized ambivalence, however, we are concerned with an aspect of character, or personality, which itself may be seen as arising from the pressures on a given group, particularly, here, those sections of the élite, such as the young and the poorer groups, who are socially and economically least secure. Socialized ambivalence is characteristic of people on whom constantly new pressures are impinging, who are pulled into opposite directions, being attracted to both and hating both. It is closely related to both hatred and fear, a projection of hatred on others. Haitian society contains a great many realistic conflict situations. The élite, unlike the masses, have no acceptable, culturally patterned way of expressing aggression, such as through magic, or through accusing others of magic, which we find among the masses. They have no evil *vodun* priests, secret societies and *zombies*, which present acceptable ways of localizing their fears for the masses. Nor do they have the gods of *vodun* to protect them. While in their childhood they became acquainted with *vodun* practices, tales and proverbs, they were later forced to reject these. Insofar as they have rejected them and are nostalgic, they are ambivalent. While the child of the masses is permitted to grow up with the beliefs and world view he acquired in childhood, the élite individual must reject his childhood world view as he grows up. It is this discontinuity in the process of maturation which is shared by all members of the élite, which leads to the lack of integration which we find in their world view and thus to their characteristic ambivalence. As their class position and the accepted orientation of their elders pulls them toward the west, their childhood pulls them away from it. With reference to socialized ambivalence, we may thus say that this typical feature of the Haitian élite is, in psychological terms, essentially based on the discontinuity of their cultural conditioning, which at the same time represents and symbolizes the diverse psychological, social and cultural pressures to which they are exposed.

While acculturation, then, involves for the masses of the Haitian people integration and incorporation of new and foreign materials, it represents, in contrast, a situation of multiple pulls for the élite, in response to which this group has developed a character structure of which socialized ambivalence is a salient characteristic.

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STANDING STONE

WILBER STOUT
Rock Mill, Lancaster, Ohio

Standing Stone, most certainly an appropriate name, was given to this conspicuous rock at Lancaster by the Wyandot Indians who belonged to the strong Shawnee Confederacy. To them this abrupt cliff of sandstone was the work of the Great Spirit and assured protection to the wigwams pitched on the plains below and ruled over by the mighty chieftain Tarhe, or the Crane. When visited by scouts from Marietta in 1790 Tarhe Town or Crane Town is said to have contained about 100 wigwams and some 500 souls. This place was also the meeting point of two important trails to distant villages (Gates). The chief of these was the Coshocton Trail which began at Shawnee Town on the Ohio River at Portsmouth, led past the salt springs at Jackson and the caves of the Hocking hills to Tarhe Town at the Standing Stone, then on past the flint quarries on Flint Ridge to the Delaware Indian center at Coshocton. The other trail, less lengthy, coursed southwestward over the hills past Amanda and across the Pickaway Plains to the chief Shawnee towns near Chillicothe where it joined the Scioto Trail or Warrior's Path. The imposing rock, Standing Stone, thus meant much to the Indians and probably also to the Mound Builders in the more distant past. Recently it has been the inspiration for narratives and movie scenes and now provides the pleasures of a fine public park. This leads to the question: what is the story of the rock formation, Standing Stone, as visioned by the geologist?

DEPOSITION OF SANDSTONE

Millions of years ago during what is known to geologists as the Mississippian age large rivers were carrying vast quantities of sand and silt into an ancient sea which then occupied much of what is now the central portion of the United States. There the waves, tides, and currents of the ocean worked the suspended matter over and over, floating away to the deeper, more quiet waters the finer parts but depositing the coarser materials, sand with some pebbles, on or along the beaches. The final result of all this action was to deposit a vast sheet of sand and pebbles varying in thickness from a few to 300 feet or more.

This formation as now outlined by geologists extends from Lancaster south to the Hocking-Vinton county line, north to Mansfield, Richland County, east into West Virginia and west to near Amanda. This stratum of sandstone is known as the Black Hand, a name given by L. E. Hicks, in 1878, to the deposit of coarse sandstone and conglomerate so well exposed at the Black Hand rock and in the gorge of the Licking River near Hanover. To the driller of petroleum and natural gas in southeastern Ohio and in northern West Virginia this reservoir of the hydrocarbons is known as the Big Injun Sand.

MARINE ORIGIN OF THIS ROCK

The question arises: what determines the marine origin of the Black Hand formation? Although this sandstone bears no or few fossils the shales above and below it and those that replace the deposit laterally yield many fine specimens of shell life that lived in this ancient sea. Our museums contain collections of the varied animal forms that existed during the Mississippian age.

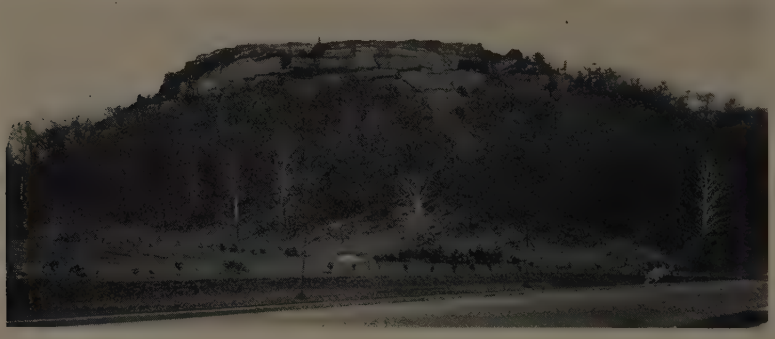
SOURCE OF SAND AND PEBBLES

Another question may be asked with propriety: what was the original source of the sand and pebbles? Both materials are composed largely of the mineral

quartz and were derived from the weathering and disintegration of the older crystalline rocks such as granite, gneiss, and schist. These when reduced by decay and sorted by water yielded silts or muds consolidated to shale, sand to sandstone, and pebbles to conglomerate. Hence the sand and pebbles in the Black Hand formation came from the old crystalline rocks on highland areas where they were broken down by various weathering agencies. The materials thus derived were carried away by streams and the coarser matter finally deposited along the shore of the ocean to form such beds as the Black Hand.

CRUSTAL MOVEMENTS

A crustal movement of long duration and of much importance geologically was a very slow sinking of the floor of the sea into a trough-like basin known as the Appalachian geosyncline or Appalachian trough. The axis or deep part of this depression extended from Alabama northeastward into New York. However, as the ocean floor in this basin sank slowly the forces of deposition or of rock building were bringing in materials to form shales, sandstones, limestones, coals, clays,



and iron ores, all of much worth. For example, through such deposition and burial the Black Hand formation, so well represented by Standing Stone at Lancaster, is covered by some 960 feet of other rocks at Pomeroy, 1,400 feet at Marietta, and 1,500 feet at Woodsfield. In general the dip of the Black Hand formation is not far from 20 feet per mile east and 12 feet per mile south. Thus, these movements in the earth's crust caused changes in dip of the rocks and allowed for the accumulation of a thick mass of strata.

APPALACHIAN REVOLUTION

Again the question may be asked: why does the Black Hand sandstone, laid down in the sea and buried by other rocks, now appear at the surface in great cliffs and hills across central Ohio from South Bloomingville, Hocking County, through Lancaster and Newark to Mansfield in Richland County? The Permian age of the geologist was "brought to a close by one of the most profound physical disturbances in the history of North America. It has been called the Appalachian Revolution because at that time the Appalachian Mountain Range was born out of the sea by upheavals and folding of the strata" (Miller). The great forces of nature thus created mountain ranges, lifted large areas into plateau-like highlands and raised other parts into broad plains. Such events elevated our region above the sea and opened the way for the next cycle, which is that of land sculpturing.

LAND PROVINCES

The land provinces of most interest to us consist of the Appalachian Mountains, the Allegheny Plateau, and the Mississippi Valley Plain. The Appalachian Mountains, with broken and contorted rocks in great ridges, extends across the eastern part of the United States from Georgia to Maine. As defined the next province, the Allegheny Plateau, embraces the highlands or hill country west of the mountain terrain and east of the central lowlands. The boundary between plateau and plain is marked by an abrupt or stair-step wall of rocks known as the Allegheny Escarpment or Front in Ohio and as the Highland Rim in Kentucky and Tennessee. This drop from the ridge tops of the hills to the flat land of the plains varies much but commonly in this region is from 325 to 400 feet. Near Lancaster good examples of this escarpment or wall are from Chestnut Ridge to the flats near Jefferson, from Lithopolis to the lowlands near Groveport, and from Ringgold to the Pickaway Plains near Circleville. The height of the Allegheny Escarpment is approximated by the wall of rock of Standing Stone.

The Mississippi Valley Plain embraces the low-lying basin extending westward from the Allegheny Plateau to the Rocky Mountains. Here the land is flat or gently rolling and often swampy with immature drainage. The northern part of Fairfield County belongs in the province of the Mississippi Valley Plain and the remainder in that of the Allegheny Plateau.

ANCIENT STREAMS-TEAYS SYSTEM

During the long interval from Permian time, when the Appalachian Revolution took place, to the present the destructive forces of weathering and erosion have eaten away the moderately level Allegheny Plateau into rugged hills and deep valleys and have lowered it somewhat in elevation. At this time it was reduced much to its present form. Thus aside from rock disintegration by weathering agencies, the chief forces in dissecting this old surface were streams, both large and small.

As far as known to geologists the first streams to affect the western part of the Allegheny Plateau were those of what is called the Teays System. The master stream—the Teays River—entered Ohio near Wheelersburg, Scioto County, flowed northwestward past Waverly, Chillicothe, London, Springfield, and Celina and entered Indiana south of the village of Willshire, Van Wert County. The stream bed of the Teays River is clearly marked by wide level flats from Wheelersburg to Chillicothe and by a deep trench filled with drift from the latter place to the Ohio-Indiana line.

Like present streams the Teays River had many branches. One of these was a large tributary known as the Groveport River which was about 150 miles in length and drained a wide basin in east central Ohio. In turn the Groveport River had a southern branch known as the Logan River. The latter stream rose south of Logan, flowed northward past Logan, Enterprise, Rock Bridge, Sugar Grove, Lancaster, and Hooker and united with the Groveport River near Carroll. The marks of the Logan River have been somewhat modified by later changes but in the main, especially in Fairfield County, the valley cut through the Black Hand sandstone and other rocks was the work of this old river of the Teays Stage. At Lancaster the floor of the Logan River stood at an elevation not far from 690 feet or some 140 feet below the level of the main part of the city. Hence here during this time the valley was broad and deep and the bordering hills were more than 400 feet in height and bold in relief. In the vicinity of Lancaster additional modifications of the surface features were caused by Bremen Creek, an eastern tributary with several branches, which had carved out a wide valley and thus aided in sculpturing the adjacent hills.

Consequently during the long interval of time from the Appalachian Revolution,

near the close of the Permian age, to the advent of the great glaciers, during the Pleistocene era, the Teays Stage streams cut deep valleys into the rock surface of the Allegheny Plateau and thereby shaped up the hills and ridges into much their present forms. Where resistant rocks as the Black Hand sandstone lay near the surface—especially near the Allegheny Escarpment—many sheer cliffs and isolated knobs remain as a result of ages of work by destructive forces in dissecting the original sheet deposit. Standing Stone shaped up largely during this cycle of surface alteration represents simply the point of a hill cut off from the main ridge by stream erosion, aided by weathering agencies.

GLACIATION

The great glaciers of Pleistocene time brought changes of importance to the surface features of Ohio. These ice sheets, three in number, left a blanket of material called drift over some 30,000 square miles of the State. The drift consists of disintegrated rocks and old soils which were reduced in size from rock flour to huge boulders, and all gathered along the way from the Canadian Highlands to the final place of deposition. In general most of it was gathered within 25 miles of where deposited. In this State the average thickness of drift in the areas affected is between 35 and 40 feet. The accumulations vary from one foot or less to 500 feet or more. Such deposits of glacial debris softened the surface features by fills in the valleys and by rounding out the outlines of the hills. Another change of importance, but less apparent, caused by the ice sheets was on the drainage patterns of the stream systems. Some streams were wiped out completely whereas others were modified by reversal of their courses, by cutting new channels locally, or by deepening older ones. The area around Lancaster was profoundly modified both by the mantles of drift left by two ice sheets and by the radical changes in the drainage systems.

KANSAN OR PRE-KANSAN GLACIER

As far as known the first glacier to reach Ohio was the Kansan or Pre-Kansan the marks of which are much obscured by later ice invasions. This early glacier appears to have advanced southward from the Canadian Highlands to about midway across Ohio. South of the ice front its chief effect was to dam the Teays River somewhere in the west central part of the State and thereby to create new outlets for the water from the old drainage basin and from that added by the melting glacier. The wall of ice thus ponded the water in the valleys of the old Teays streams into long finger lakes which eventually flooded over and initiated a new drainage system much different from the former. Collectively the new streams thus originated are known as the Deep Stage drainage.

DEEP STAGE DRAINAGE—NEWARK RIVER

In central Ohio the master stream of the Deep Stage system was the Newark River. It rose east of Dover, flowed southwestward past Newcomerstown, Coshocton, Newark, Groveport, Circleville, Chillicothe, and Waverly to Portsmouth and there joined the Pomeroy River to form the Cincinnati River which flowed on westward past that city. The streams of this period cut deep valleys, 80 to 100 feet or more below the old Teays levels, hence the name Deep Stage drainage. The rock floor of the old Newark River, now deeply buried, has an elevation above sea of approximately 500 feet at Chillicothe, 520 feet at Circleville, 550 feet at Canal Winchester, and 594 feet at Newark. At present this old river bed is buried by 200 to 300 feet or more of glacial drift and on this account affords a fine water supply.

Of particular interest in this account of Standing Stone is a southern tributary of the Newark River of Deep Stage time known as the Lancaster River. The latter stream rose south of Haydenville, flowed northward past Logan and Lan-

caster, and joined the master stream near Canal Winchester. The new stream, Lancaster River, occupied much the same basin and bed as the older Logan River and had tributaries similarly located. However, during this period of erosion the Lancaster River cut the rock floor some 100 feet deeper into the soft shales under the Black Hand formation, widened the valley of the former stream to some extent, and formed more abrupt walls in the bordering resistant massive sandstone. The undercutting in the soft shale below the sandstone formed the cliff. Assuredly most of the work in carving out the great rock, Standing Stone, was done by the Logan River of Teays Stage time and then largely finished by the Lancaster River in the Deep Stage period. Many other knobs and isolated groups of hills in this vicinity also resulted from the dissection of the vast sheet deposit of Black Hand sandstone during these two cycles of erosion. Standing Stone is simply an outstanding example.

ILLINOIAN GLACIER

Again glaciation prevailed in Ohio. The second ice invasion known as the Illinoian covered the central and the western parts of the State and left a terminal moraine definitely marked from Brinkhaven southward past Hanover, Fultonham, Sugar Grove, Chillicothe, and Cynthiana to the Ohio River at Ripley. It not only covered some 23,000 square miles of Ohio with glacial debris but caused radical changes in the drainage systems in the remaining portion.

POST-ILLINOIAN DRAINAGE—HAYDENVILLE RIVER

New streams were now formed through the influence of this ice sheet. At this time the headwaters of the north-flowing Lancaster River were trapped by the ice border standing across the valley at Sugar Grove. The accumulated waters of the basin, thus ponded, found an outlet over a low divide near the Athens-Hocking County line, flowed down the valley of Stewart Creek of Deep Stage time, and united with the new major stream, the northeastward-flowing New Martinsville River. For definition the new stream formed from part of the old Lancaster River and from others is called the Haydenville River. It flowed southward from Sugar Grove past Logan, Haydenville, and Athens to Hockingport and outlined, with little subsequent modifications, that of the present Hocking River.

North of the terminal moraine at Sugar Grove the chief effect of the Illinoian glacier was to fill to some extent the deeply cut valleys of the Lancaster River and its tributaries and to blanket the bordering hills with a thin coating of rock debris. Probably this mass of ice in passing over Standing Stone scoured its walls to some extent but certainly it had little to do with shaping the great rock.

WISCONSIN GLACIER

The last ice sheet to ivade Ohio, some 30,000 years ago, was the Wisconsin, the deposits of which are very apparent over approximately 26,460 square miles of the State. It made many changes in the surface features, leveling certain areas to a smooth, even plain, piling up drift in others to knobby hills and billowy ridges, and filling certain valleys with great quantities of outwash materials. In Fairfield County the Wisconsin glacier lacked a few miles of extending as far south as the Illinoian. The terminal moraine or border of the last ice passed irregularly through southeastern Richland, northern Berne, southeastern Hocking, and northwestern Madison townships. This glacier certainly passed over Standing Stone as a granite boulder of Canadian origin still remains upon the summit. However, the ice did little in sculpturing the walls of the great rock, yet it left a mantle of drift around the base of this hill as well as over the surrounding countryside. In general in the Lancaster region the chief effect of the Wisconsin glacier was to add more accumulations to that already deposited by the Illinoian ice, to the fill in the old Logan and Lancaster River valleys. A result of regional

importance of this cycle of glaciation was the inauguration of a new system of drainage known as the Post-Wisconsin.

POST-WISCONSIN DRAINAGE—PRESENT STREAMS

In this paper only the streams of the Post-Wisconsin system in the Lancaster region need be considered. Since the Haydenville River of the Post-Illinoian cycle was largely beyond the front of the Wisconsin glacier the water from the melting ice simply found an outlet through this well cut valley. The present Hocking River is therefore only a slightly modified form of the older Haydenville River. As the ice receded the new Hocking River extended its headwaters out onto the glacial plain to the northern part of the county. The present stream has had no evident effect on Standing Stone. The modifications on the rock, in the 30,000 years since glaciation, have been through weathering, case-hardening parts of the surface by cementation, and disintegration in places of some of the more impure rock.

SUMMARY

Standing Stone remains as a monument to many forces and events in a long story mainly explained by geology. The occurrences may be recorded as follows:

1. A thick body of sandstone, now known as the Black Hand formation, was laid down along the shore of the sea.

2. Through slow sinking of the ocean floor a great mass of other rocks were deposited above the Black Hand sandstone.

3. Next during profound earth movements, called the Appalachian Revolution, these rocks were raised to a land mass much above the sea.

4. Rains fell and streams then began the work of cutting valleys in the land. The first system of streams, named the Teays, carved deep troughs and basins in the rock surface and shaped up the higher parts into hills and ridges.

5. One of the Teays streams, the Logan River, cut a wide, deep valley northward past Lancaster and shaped up Standing Stone from the thick Black Hand sandstone. The main part of the work in reducing the rock to its present form was done at this time.

6. An early glacier, the Kansan or Pre-Kansan, buried or changed these early streams but led to the formation of a new river system, known as the Deep Stage.

7. One of these was the Lancaster River which flowed northward in the trough of the older Logan River but cut some 90 feet deeper into the rocks below.

8. The Lancaster River evidently aided in forming the abrupt walls of Standing Stone as it eroded away the soft shales from under the massive, resistant sandstone formation.

9. The second glacier, the Illinoian, passed over the Lancaster area and on southward to Sugar Grove. It scoured the walls of Standing Stone to some extent and left a thick deposit of drift around its base.

10. The Illinoian drift wiped out or modified many of the older streams. As affecting the Lancaster region the chief new stream formed was the Haydenville River which flowed southward from the ice front for an outlet to the sea. This stream had little or no effect on Standing Stone.

11. The third glacier in Ohio, the Wisconsin, passed southward over Standing Stone and beyond Lancaster. It made little change in the rock structure but added more drift around its base.

12. The Wisconsin ice invasion then led to the formation of the now existing system, the Hocking River and its tributaries. Standing Stone has not been affected by the present streams.

Hence, Standing Stone, an isolated knob of Black Hand sandstone, was formed mainly by the cutting of valleys by two old streams, the Logan and the Lancaster rivers, and its walls were scoured by two glaciers, the Illinoian and the Wisconsin. This rock named so appropriately by the Indians certainly merits a prominent place in the scenic features of Ohio.

CAULIFLOWER, A NEW RECESSIVE MUTATION IN TOMATO[1]

ELTON F. PADDOCK AND L. J. ALEXANDER
Department of Botany and Plant Pathology, The Ohio State University, Columbus 10, and The Ohio Agricultural Experiment Station, Wooster

A new, apparently mendelian recessive character, here proposed to be known as cauliflower, first came to the attention of the writers in a field planting of F_2 tomatoes at Wooster, Ohio, in 1949. As far as the writers have been able to ascertain this mutant has not been previously observed or reported. On those plants where the character is found, each individual inflorescence is of the cauliflower type (fig. 1). Plants which produce cauliflower type inflorescences in the field also produce them when grown under glass. The earliest inflorescence primordia visible to the naked eye are already abnormal and resemble a head of cauliflower. The inflorescence stem system is multibifurcated. This abnormality apparently begins extremely early in development (fig. 2). The bifurcations are not exactly equal and the inequality alternates from side to side at successive branches with the result that in old inflorescences a main axis can be traced. The smaller branches seem to arise in the axil of a filiform bract in the younger portions of old inflorescences.

The structure found where each flower should be is actually a growing point. This is evident because the inflorescence becomes progressively larger and more bifurcated as the season advances. Some inflorescences reach a size of 12 inches across, and feel very much like a large sponge when grasped. The growing points are not enclosed by leaf or scale primordia (figure 2). In some instances, normal leafy stem growth has come from a cauliflower inflorescence. However, all inflorescences on the internodes of the resumed growth are of the cauliflower type (fig. 3).

Cauliflower is similar to complex (*ss* genotype) in that both are multibifurcate. They differ in that cauliflower is more extensively bifurcated and in that a flower never has been seen to arise on a cauliflower type inflorescence (fig. 4).

The plants which originally produced the cauliflower type inflorescence were observed in three field plots each of which had been planted from the seeds of a single fruit. All three fruits had come from the same F_1 individual. Cauliflower-producing plants occurred in approximately a 3: 1 ratio (tables 1 and 2). No

TABLE 1

Pedigree of progenies in which the new cauliflower type of inflorescence has appeared.

P_1	P. I. 148720 (Baldwin's Brazilian)	× P. I. 79532 (Missouri Accession 160)
F_1	7 plants, all normal 7 selfed	
F_2	6 did not segregate 1 segregated (162 normal: 70 cauliflower) 30 from one field plot of the segregating progeny selfed	
F_3	13 did not segregate 17 segregated (365 normal: 106 cauliflower) 33 from two of the segregating progenies selfed	
F_4	11 did not segregate 22 segregated (419 normal: 148 cauliflower) 7 from one segregating progeny selfed	
F_5	2 did not segregate 5 segregated (84 normal: 16 cauliflower)	

[1]Experiment Station Journal Article 31.

TABLE 2

Frequency of cauliflower inflorescence producing plants in F_2, F_3, F_4, and F_5 generations.

GENERATION TESTED		NUMBER PLANTS NORMAL	NUMBER PLANTS CAULIFLOWER INFLORESCENCE	TOTALS	TOTALS			HETEROGENEITY		
					χ^2	df	P	χ^2	df	P
F_2 Generation—6 samples from single F_1 plant.										
Totals of 3 Fusarium inoculated samples	Observed	96	40	136	1.412	1	0.30–0.20	0.102	2	0.98–0.95
	Expected	102	34							
Totals of 3 uninoculated samples	Observed	66	30	96	2.000	1	0.20–0.10	1.932	5	0.50–0.30
	Expected	72	24							
Total observed		162	70	232	3.372	1	0.10–0.05	2.074	5	0.95–0.70
F_3 Generation—17 segregating progenies.										
Totals of 12 Fusarium inoculated progenies	Observed	288	75	363	3.644	1	0.10–0.05	10.240	11	0.70–0.50
	Expected	272	91							
Totals of 5 uninoculated progenies	Observed	77	31	108	0.790	1	0.50–0.30	2.461	4	0.70–0.50
	Expected	81	27							
Total observed		365	106	471	2.608	1	0.20–0.10	14.527	16	0.70–0.50
F_4Generation—22 segregating progenies.										
Totals of 22 uninoculated progenies	Observed	419	148	567	0.368	1	0.70–0.50	22.326	21	0.50–0.30
	Expected	425	142							
F_5 Generation- 5 segregating progenies.										
Totals of 5 uninoculated progenies	Observed	84	16	100	4.320	1	0.05–0.02	0.591	4	0.98–0.95
	Expected	75	25							
Hybridizations of known heterozygotes—12 progenies.										
Totals of 12 uninoculated progenies	Observed	420	154	574	1.024	1	0.50–0.30	4.826	11	0.95–0.90
	Expected	430	144							
Totals for all 62 tested progenies.										
Totals	Observed	1450	494	1944	0.176	1	0.70–0.50	55.860	61	0.70–0.50
	Expected	1458	486							

cauliflower plants appeared among 28 field plots from single fruits of six sister F_1 individuals of the same cross. It therefore seems likely that the actual mutation occurred early in the ontogeny of this one particular F_1 plant. The original cross had been made between P.I. 148720 (designated Baldwin's Brazilian) as female parent and P.I. 79532 (known as Missouri Accession 160) for the purpose of studying the linkage relationships of the Fusarium immunity locus *I*, *i*. Consequently, the F_2, in which the mutation became homozygous, was composed entirely of plants which had survived a severe Fusarium inoculation and presumably were either *II* or *Ii* in genotype.

To determine whether the Fusarium inoculation had affected the observed ratio of cauliflower versus non-cauliflower, another planting of each of the three seed remnants was made and uninoculated plants were classified (table 2). Again the deviations from a 3: 1 ratio are not significant. Thus, there is no apparent effect on the segregation of cauliflower attributable to Fusarium inoculation. It may therefore be presumed that the *I*/*i* and cauliflower loci are not linked.

Seed was harvested at the end of the 1949 season from each of 30 of the 31 non-cauliflower Fusarium inoculation survivors present in one of the three progenies. Seeds from 13 of these were planted for the F_3 generation in the greenhouse during the ensuing winter without being subjected to Fusarium inoculation. Seeds from the other 17 were not planted until the following spring. These latter 17 progenies were subjected to a Fusarium inoculation and raised in the field. The choice of the first 13 was made by using the seed from the first 13 consecutive normal plants in the field plot.

If cauliflower is inherited as a simple mendelian recessive, not linked with *I*/*i*, two-thirds of these 30 progenies should have segregated and in each such progeny the segregation should have approximated a 3: 1 ratio. Segregation did occur in five of the non-inoculated progenies and in 12 of the inoculated progenies (tables 1 and 2). The heterogeneity χ^2 for these two ratios of 5: 8 and 12: 5 is 3.774 with 1 degree of freedom and P is 0.10–0.05. This heterogeneity is undoubtedly spuriously large because among the 13 non-inoculated progenies, there were five non-segregators in which there were fewer than 16 plants each. Some of these five might have proved to be segregators if greater numbers of F_3 offspring could have been raised. Even so, the above χ^2 is not significant and it is permissible to treat all 30 tested progenies as a single sample of 17 segregators to 13 non-segregators. The χ^2 for the deviation of 17: 13 from the expected 2: 1 is 1.350 with 1 degree of freedom and P is 0.30–0.20. Here again, the χ^2 is probably spuriously large for the same reason as above.

The same 30 progenies were also classified for stem hairiness. The F_2 generation had been also so classified. The F_3 generation was classified as a check on the classification of the F_2 generation. Five of the 30 F_2 individuals had been classified as hairy (*hh* genotype). These five F_2 individuals produced only hairy individuals in the F_3 generation. No other F_3 progeny was composed entirely of hairy plants. In other words, in all 30 instances the direct F_2 classification was confirmed by the F_3 progeny test. The F_3 generation data in addition made it possible to distinguish between *HH* and *Hh* among the 25 non-hairy F_2 individuals. The frequencies of the six possible combinations of cauliflower genotype and stem hairiness genotype thus found among these 30 F_2 individuals are summarized in table 3. None of the χ^2 values are significant when testing the expectation of 1: 2: 1: 2: 4: 2 ratio. There is thus no basis for presuming linkage between the *H*/*h* and cauliflower loci. In table 3 the 17 Fusarium inoculated progenies are presented separately from the 13 non-inoculated progenies. The heterogeneity χ^2 reveals that the Fusarium inoculation apparently had no effect on segregation of the other two loci.

The data from the 17 inoculated progenies could be made to bear on the question of linkage between the *I*/*i* and cauliflower loci by breaking down each of the six categories of table 3 into two components based on whether or not Fusarium

FIGURE 1. Branch from a cauliflower tomato plant. Every inflorescence is of the cauliflower type. × ca ⅓.

FIGURE 2. Histological section of a cauliflower type tomato inflorescence primordium. The growing points are not enclosed by leaf or scale primordia. One filiform bract primordium is visible above left center. × ca 50. (Preparation by Elizabeth Leeper.)

FIGURE 3. Portion of a cauliflower type inflorescence on which normal leafy stem growth has resumed. Inflorescences on this new growth continue to be of the cauliflower type. At each younger bifurcation, a subtending filiform bract is present. × ca 1.

FIGURE 4. Complex (*ss* genotype) inflorescence resembles cauliflower but has flowers. The two are not allelic. × ca ½.

2

4

3

TABLE 3

Frequency of 6 possible combinations of cauliflower genotype with stem hairiness genotype among 30 F_2 individuals as determined by F_3 progeny tests.

		No Cauliflower in F_3			Cauliflower in F_3					
		None hairy in F_3 (*HH*)	Some hairy in F_3 (*Hh*)	All hairy in F_3 (*hh*)	None hairy in F_3 (*HH*)	Some hairy in F_3 (*Hh*)	All hairy in F_3 (*hh*)	χ^2	df	P
17 Fusarium inoculated F_3 progenies		1	2	2	4	6	2	1.108	5	0.98–0.95
13 uninoculated F_3 progenies		3	4	1	0	5	0	8.943	5	0.20–0.10
Totals	Observed	4	6	3	4	11	2	3.300	5	0.70–0.50
	Expected	2.5	5.0	2.5	5.0	10.0	5.0			

Heterogeneity $\chi^2 = 6.751$; df = 5; P = 0.30–0.20

TABLE 4

Frequency of 4 possible combinations of cauliflower genotype with Fusarium reaction genotype among 17 F_2 individuals as determined by subjecting their F_3 progeny to Fusarium inoculation.

	No Cauliflower in F_3		Some Cauliflower in F_3				
	All survived in F_3 (*II*)	Some did not survive in F_3 (*Ii*)	All survived in F_3 (*II*)	Some did not survive in F_3 (*Ii*)	χ^2	df	P
Observed	3	2	4	8	1.583	3	0.70–0.50
Expected	1.9	3.8	3.8	7.5			

susceptible individuals were present in the respective F_3 progenies. However, when this is done, the frequency in each class becomes too low to justify the use of the χ^2 method of analysis. This criticism actually applies already to the data of table 3. These data are therefore presented in table 4 in a manner that disregards the stem hairiness genotype. The deviation from a 1: 2: 2: 4 ratio is not significant, hence, apparently the cauliflower and *I/i* loci are not linked. On the basis of other hybridizations, and without knowledge of the work of Butler (1951), Paddock (1950) tentatively assigned the *I/i* locus to linkage group 5.

In the F_4 generation, 33 progenies were raised in the greenhouse during fall without Fusarium inoculation. Their parents include all the non-cauliflower members of two segregating F_3 progenies. Again it was expected that some cauliflower plants would appear in approximately two-thirds of these progenies and that in each such segregating progeny approximately one-fourth of the plants would have the cauliflower character. The two-thirds expectation was realized exactly (table 1) with 22/33 progenies segregating. Deviation from the one-fourth expectation is not significant (table 2).

F_5 generation data have been completed in the greenhouse during winter from seven F_4 individuals, all being non-cauliflower members of a single segregating F_4 progeny. None of the seven were subjected to Fusarium inoculation in F_5 generation. Among the seven progenies, five segregated (table 2). χ^2 for this deviation from a 2: 1 expectation is only 0.700 and P is 0.50–0.30 with 1 degree of freedom. The heterogeneity χ^2 for the ratios 5 : 8, 12 : 5, 22 : 11, and 5 : 2 is 4.736 with 3 degrees of freedom and P is 0.20–0.10. Therefore all 70 tested progenies may be treated as a single sample of 44 segregators to 26 non-segregators. The χ^2 for the deviation of 44 : 26 from the expected 2 : 1 is 0.4583 with 1 degree of freedom and P is 0.50–0.30.

The above F_4 progeny was chosen for F_5 study because all the cauliflower individuals in it had dwarfed inflorescences, while the non-cauliflower individuals had normal sized inflorescences. The dwarfing affected only the inflorescences. Such dwarfed cauliflower inflorescences had been noted from time to time in preceding generations on individual glasshouse raised plants but never on field raised plants. Among the five segregating F_5 progenies, three produced only the dwarfed form of the cauliflower inflorescence. In the other two progenies, there was only one individual in each progeny with the usual large form of cauliflower inflorescence. These facts indicate the existence of modifier genes which apparently are effective only when the plants are raised under glass. The matter is being investigated further.

Twelve progenies from six reciprocal hybridizations among five known cauliflower heterozygotes have been studied. The five parent individuals included three representatives from the F_4, one from the F_3, and one from the F_2. Each of the latter two was hybridized reciprocally with each of the former three. In each of the 12 progenies, the deviation from a 3: 1 expectation is not significant. The totals of all 12 progenies are in table 2.

The above two known cauliflower heterozygotes of F_2 and F_3 were also crossed reciprocally with MacArthur strain 706, as ovule parent with MacArthur strain 902, and as ovule parent with our woolly selection from P. A. Young strain G1075. From the reciprocal crosses, 13 plants among 18 had some cauliflower offspring after selfing. From the crosses with MacArthur strain 902, two plants among six had some. From the crosses with our woolly selection, 14 among 26 had some. In each of the three crosses, the deviation from a 1: 1 expectation is not significant. Their heterogeneity χ^2 is 2.002 with 2 degrees of freedom and P is 0.50–0.30. It is therefore permissible to treat all 50 progenies as a single sample of 29 segregators to 21 non-segregators. The χ^2 for the deviation of 29: 21 from the expected 1: 1 is 1.280 with 1 degree of freedom and P is 0.30–0.20. These 50 progenies qualify as F_2 repulsion tests of linkage. Discussion of their bearing on the linkage relation-

ships of the cauliflower locus will, however, be deferred until data can be acquired from back-crosses as well.

The crosses with MacArthur strain 706 are also a test for allelism between the cauliflower and complex (*S s*) loci. Since neither cauliflower nor complex appeared in any of the 156 offspring observed, it is concluded the genes governing these two characters are not allelic. The writers, therefore, propose the symbol *ca* for the gene governing the cauliflower character.

There is considerable remnant seed on hand from progeny test identified *Ca/ca* plants. A sample will gladly be sent upon request.

SUMMARY

A new apparently mendelian recessive character, here proposed to be known as cauliflower and symbolized by *ca*, has been studied in four successive generations. There is no apparent linkage of the cauliflower locus with either the Fusarium immunity locus (*I i*, probably group 5) or the stem hairiness locus (*H h*, group 7). The cauliflower locus and the complex locus (*S s*) are not allelic. There is some indication of the existence of modifier genes causing a dwarfed form of cauliflower.

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The Geography of Europe. *George D. Hubbard.* Appleton-Century-Crofts, Inc. New York. Second Edition. 1952. xvii+870 pp. $6.75.

Europe, having undergone two major wars within a 25-year period, remains today one of the most challenging regions of the post-war era. Anyone who undertakes to treat adequately and comprehensively the essential features of the geography of Europe, a continent small in size but great in numbers of problems, assumes a task of immense proportions. The author, professor-emeritus of Oberlin College, states his purpose: "To prepare a textbook in the geography of Europe for American colleges and universities; to make a book of interest to students of European history, economics, political science, sociology, and diplomatic service, and to furnish information to the traveler and the general reader."

The general plan of the book includes climatic divisions and grouping of the states as well as usage of physical patterns for subdivisions of the continent and of the national domain. In Part I, Introductory Section, the author has succeeded well in presenting the essential physical geographical elements. Chapter 5, "Changes and Conditions Induced by State of War," would prove more effective, however, if placed in the summary portion of the text where the reader would be more qualified to evaluate the over-all picture. The 33 regional chapters are organized in an orderly manner so that the significant features, position, geology, climate, geographic regions, industries, economic conditions, trade, and people are readily available to the reader.

A set of review questions for assistance to students as well as instructors with limited geographic background, concludes each chapter. The bibliographies at the end of the chapters should facilitate reference and prove especially useful to those interested in a more intensive study of the individual countries. Numerous clear-cut maps and a wise selection of photos add much to the balance of the text. Unfortunately statistical information on production, exports, and imports, data necessary to an understanding of Europe's present-day problems, is lacking.

Professor Hubbard concludes his volume with a rather unique section entitled "Geography in the Fourth Dimension." In three philosophical chapters attention is centered on the historical aspect of agriculture, commerce, and civilization.

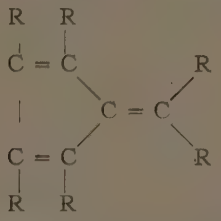
The author should be congratulated on a text which will undoubtedly have wide acceptance because of its three outstanding qualities—readibility, attractiveness, and timeliness.

WILLIAM N. HARRIS

THE ULTRAVIOLET SPECTRA OF A SERIES OF FULVENES

JESSE H. DAY AND JOHN C. LUKMAN[1]
Department of Chemistry, Ohio University, Athens

Fulvenes were first prepared by Thiele (1900) by the alkaline condensation of cyclopentadiene with various ketones and aromatic aldehydes. Fulvenes are highly colored and are characterized by an interesting kind of multiply conjugated double bonds:



The R groups may be hydrogen, alkyl or aryl groups. The parent compound, fulvene itself, in which all the R's are hydrogen, has not been successfully prepared in spite of occasional literature references to it. Sklar (1937) refers to dimethyl fulvene incorrectly as fulvene itself. Wheland (1941) and Pullman, Pullman and Rumpf (1948) refer to calculations for the hypothetical compound fulvene, though the non-existence of the substance is not apparent from their papers.

There has been no systematic study of the absorption spectra of the unsubstituted cyclopentadiene derived fulvenes. In spite of the fact that there are potentially as many such compounds as there are aldehydes and ketones combined, not more than a dozen simple fulvenes with aliphatic groups (in the 6, 6 position) have been previously reported, and of these, fulvene and methyl fulvene have not been isolated. The highly arylated fulvenes and those derived from indene and fluorene have been more thoroughly studied.

EXPERIMENTAL

The fulvenes were prepared by the method of Thiele (1900), except the cyclopentylidene cyclopentadine and cyclohexylidene cyclopentadiene; which were made by the method of Kohler and Kable (1935). The furfurylidene cyclopentadiene was best purified by ether extraction followed by recrystallization from petroleum ether.

Ultraviolet and visible absorption spectra were obtained using the Beckman D U spectrophotometer. A standard solution in absolute methanol was made of each fulvene, and that solution diluted quantitatively until the fulvene concentration was low enough to permit optical density measurements over the desired range.

Refractive indices were measured with an Abbe refractometer, using daylight. Approximate molecular weight determinations were made cryoscopically in benzene solution with a Beckman melting point apparatus and usually agreed within 2 percent of theoretical. This check was made partly to determine purity and partly to make sure that there was no accumulation of polymerization or oxidation products. All measurements were made as quickly as possible on freshly prepared material.

[1]Abstracted in part from a thesis by John C. Lukman, submitted in partial fulfillment of the requirements for the degree Master of Science, at Ohio University, Athens, Ohio.

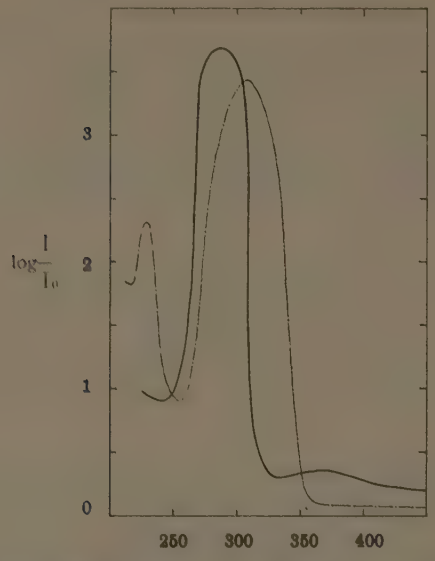


FIGURE 1. The optical density D log I/I for dimethyl fulvene (solid line) and phenyl fulvene, plotted against wave length in microns. Solutions of the fulvenes were 0.00008 M in absolute methanol.

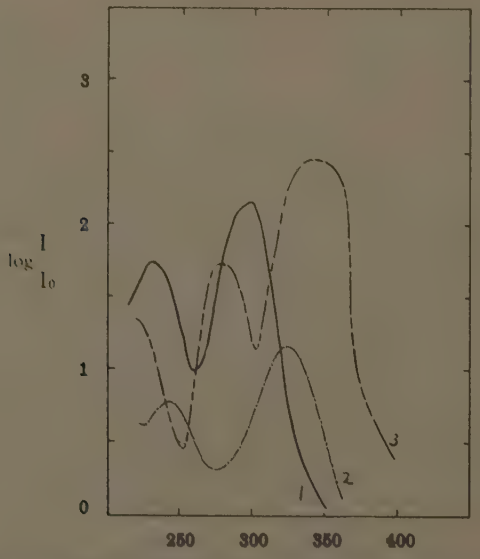


FIGURE 2. The optical density D log I/I plotted against wave length in microns for methyl phenyl fulvene (solid line), diphenyl fulvene (dotted line), and furfurylidene cyclopentadiene (dash line). Solutions were 0.00005 M in absolute methanol.

RESULTS

Some physical properties for eleven fulvenes are tabulated in table 1. Methyl n-amyl fulvene has not been previously reported. (Calc. C 88.82%, H 11.18%. Found: C 88.76%, H 11.34%) Our data for the other compounds are given because they are supplementary to the data in the literature or are valuewise different.

Methyl n-amyl fulvene is an orange colored oil which slowly hardens in air and is quite similar in appearance, odor and behaviour to the other simple fulvenes.

TABLE 1

Physical constants of a series of fulvenes.

Compound	Boiling Point		Refractive Index	Color
	Our Data	Literature		
dimethyl fulvene[1-2]	66–68 (25 mm) 156–158 (760 mm) −13 (melting pt.)	46 (11 mm) 153–154 (717) about 4	1.5338	Yellow-orange
methyl ethyl fulvene[2-3]	67– 70 (25 mm) 165–166 (760 mm)	62.5 (13 mm)	1.5423	Yellow-orange
methyl n-propyl fulvene [4]	177–178 (760 mm)	61–63 (9 mm)	1.5245	Orange
methylisopropyl fulvene[5]	181–182 (760 mm)	67–68 (10 mm)	1.5292	Orange
methyl n-amyl fulvene	213–214 (760 mm)		1.5166	Orange
cyclopentylidene cyclopentadiene [6]	80–82 (25 mm)	55–57 (2 mm)	1.5472	Yellow
cyclohexylidene cyclopentadiene[6]	80–83 (25 mm)	78–80 (25 mm)	1.5474	Yellow
furfurylidene cyclopentadiene	70–72 (25 mm)		1.5845	Orange
phényl fulvene [1]	3 to 5 (melt.)	about 31	1.5541	Deep red
methyl phenyl fulvene[1]	147–151 (25 mm)	130.5 (10.5 mm)	1.5596	Red oil
diphenyl fulvene[1]	81 (melt. pt.)	82 (melts)		Crimson plates

[1]Thiele (1900). [2]Thiele and Balhorn (1906). [3]Engler and Frankenstein (1901). [4]Halpern (1943). [5]Kazanskii and Gokhanov (1949). [6]Kohler and Kable (1935).

The characteristic absorption spectrum of the fulvene molecules displays a strong absorption peak at 265–271 mu and a weaker absorption peak between 352 and 360 mu. The spectra are virtually identical for dimethyl fulvene, methyl ethyl fulvene, methyl n-propyl fulvene, methyl isopropyl fulvene, methyl n-amyl fulvene, cyclopentylidene cyclopentadiene and cyclohexylidene cyclopentadiene. The absorption peaks shift slightly toward longer wave lengths as the size of the molecule is increased. Stark and Steubing (1908) report strong absorption bands for dimethyl fulvene at 270 and 365 mu, which differs slightly from our data.

The conjugation of the fulvene group at the 6 position with one phenyl group shifts the maximum absorption peak about 30 mu toward the longer wave lengths and decreases the absolute amount of absorption. The conjugation of the fulvene

with two phenyl groups in the 6 position shifts the maximum absorption peak about 25 mu more. A new peak at 230–245 mu is seen in these phenyl fulvenes, which may correspond to a similar peak in the other fulvenes which is below the range of the instrument. In these phenyl fulvenes, the small absorption peak at around 360 mu is no longer found.

Furfurylidene cyclopentadiene exhibits a curve somewhat similar to that of diphenyl fulvene, with a further shift in the maximum absorption peak of about 20 mu.

Grateful acknowledgement is made to Paul Hayes for his considerable assistance with the spectrophotometric work, and to Richard Bonham for checking melting points.

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Concepts and Methods of Theoretical Physics. *Robert B. Lindsay.* D. Van Nostrand Co., Inc. New York. First Edition. 1951. x+515 pp. $7.00.

"This book is intended as an introduction to the methods of theoretical physics for students who have had intermediate college courses in physical mechanics and electricity as well as advanced calculus and elementary partial differential equations. As the title implies, the emphasis is on the development and clear definition of physical concepts and the analysis of methods rather than the detailed presentation of all the factual content of theoretical physics which the student will naturally need in pursuing graduate physics to the doctorate. Attention is focused on the postulational character of physical theories, and . . . the emphasis is primarily on the physical meaning of the results of analysis rather than on the analysis itself." Thus, in his preface, does Prof. Lindsay state the aims and level of his book. He achieves these aims by his very clear exposition of the material, concrete examples, careful definition of all terms and symbols, and by the use of numerous references, in footnotes, to direct the student's attention to other treatments and original articles. The problems at the end of each chapter are approximately chosen and should give the student excellent review of the material covered in that chapter.

The first half of the book deals with "particle" physics and proceeds from the treatment of the single particle very logically to collections of particles and thence to statistical methods, with thermodynamics treated as a deduction from physical statistics. A brief survey of quantum mechanics closes this portion of the book. "Field Physics," the title of the last half of the book, emphasizes the application of the field concept to deformable solids and fluids and to electromagnetic fields. Classical electron theory and special relativity are the closing topics.

Since Prof. Lindsay starts many of his topics (e.g., the concepts of mass) at an elementary level, and intersperses the mathematics with a great deal of descriptive material, this book would serve as an excellent text at the beginning graduate level; it would likewise be a desirable reference book for graduate students and teachers of undergraduate courses in mathematical physics.

HOWARD N. MAXWELL

RACIAL SENESCENCE IN RELATION TO THE THEORY OF NATURAL SELECTION

W. L. McATEE
3 Davie Circle, Chapel Hill, N. C.

The birth and growth, decline and death of the individual are phenomena so apparently fundamental and universal as to raise the question whether they do not apply also to groups of individuals. It is in fact observable that they do apply to human families, tribes, and races (Gini, 1930), so why not to species, orders, and phyla in the organic world in general.

Thoughts in this direction are not mere speculation for as a result of experimental studies it has been determined that "populations grow in size according to the same mathematical law that individual animals and plants follow in the growth of their bodies in size" (Pearl, 1925, p. 208). Arber (1920, pp. 211 213) has summarized evidence showing that plants introduced into new environments first have a mere foothold, then run a course "through opulent maturity, to a point approaching senility, which may ultimately lead to complete extinction." The history of various introduced animals leads to a similar conclusion.

Tolmachoff (1930, p. 283) points out that while the preservation of a race is dependent upon the ability of the organisms composing it to reproduce, there is a decrease of reproductive power in the higher and more specialized animals. He considers that advancing sterility "is probably the axis on which the whole process of extinction revolves."

Child (1915, pp. 465, 194) who has written a book on the subjects of "Senescence and Rejuvenescence" states "Senescence is a characteristic and necessary feature of life and occurs in all organisms," and "That a process similar to senescence has occurred in the evolution of the higher organisms from the lower is suggested by various lines of evidence."

Woltereck (1933, p. 518) takes the view that senescence is a universal phenomena, saying: "This remarkable periodicity of a plastic and a non-plastic stage an an immanent factor is not confined to the great organic types, the classes and orders of animals and plants, and the small types, the single genera or species. Every individual of every kind of organism, man included, shows the same periodicity, the same characteristic curve of development, beginning with the time of youth, rich in potentialities, further continuing as a period of maturity, the potentialities to change more and more, becoming lost, and finally showing the decline, the old age without potentialities, then the end. The same curve, not formed from outside, but immanent in all organisms, in individuals, in species, in the great types."

It is significant that paleontologists from their scrutiny of the history of organisms through vast periods have been especially attracted to the theory of senescence. For a conspicuous instance, Alpheus Hyatt "believed that the race, like the individual, has only a limited store of vitality and that both must develop, progress, decline, and die in obedience to one and the same law" (Mayer, 1911, p. 137). Hyatt was led to these views by a study of the fossil Ammonites and other shells. Beecher (1901, p. 98) relates "that the greatest development of spinose organisms occur just after the culmination of a group, and, as this period clearly represents the beginning of the decline of the vitality of the group, the spines are to be taken as the visible evidence of this decadence. A similar observation has been made by Packard, who after passing in review the geological development of the Trilobita, Brachiopoda, and Ammonoidea, states that 'these types, as is well

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known, had their period of rise, culmination, and decline, or extinction, and the more spiny, highly ornamented, abnormal, bizarre forms appeared at or about the time when the vitality of the type was apparently declining.'" Haldane (1935, pp. 27, 28) refers to the matter in the following language, "Now this process of 'racial senescence' was not peculiar to the Ammonites . . . It seems to have occurred also in the Graptolites, Foraminifera, and other groups . . . It is not very easy to reconcile with evolution by natural selection."

In any event, accounting for such extinctions by a hypothesis of racial senescence, analogical with that of individual decline, seems preferable to one in any way involving natural selection. The term natural selection, in itself misleading, is unjustifiably applied to the results of assumed selective mortality prior to reproduction. Convincing argument can be made, but it is obvious also to ordinary observation, that mortality regularly leaves an average, not a selected, sample of the population. It is a stabilizing (Petrunkevitch, 1924) or conservative, not a progressive or evolving, influence. It neither causes nor guides the course of evolution which is orthogenetic.

The striking size and armament of some of the extinct animals have attracted wide attention and have prompted such remarks as that, "characters appear to go on developing past their point of maximum utility" and "One is left with the impression that the evolutionary process somehow acquired a momentum which took it past the point at which it would have ceased on the basis of utility" (Haldane, 1935, p. 23). As a specific case in point, Trueman (1922, p. 265) notes that curvature of the left valve of the oyster (*Gryphaea*) evolved until it pressed against the right valve interfering with the opening of the shell, and he remarks, "it is obviously difficult to account for evolution in a direction that inevitably leads to the extinction of the lineage, if evolution is the result of the operation of natural selection." In such cases the principle of natural selection cannot apply, for only useful variations can be selected. Postulation of an evolving force or "momentum" seems unavoidable.

"The geological record is full of cases where the development of enormous horns and spines . . . has been the prelude to extinction. It seems probable that in some of these cases the species literally sank under the weight of its own armaments" (Trueman, 1922, p. 120). Again the conclusion is unfavorable to the theory of natural selection, for in cases where the course of evolution is toward extinction it cannot result from a process that "works solely by and for the good of each being" (Darwin, ? 1912, p. 472).

However, races may become senescent without developing extravagantly in any obvious way. Faunas and floras of remote geologic times as a rule are extinct in their entirety, yet they included small and simple, as well as the large and elaborate, forms. If we can reason as to their prevalence from present conditions, the relatively unmodified types must have been numerically preponderant. The large and heavily armored organisms naturally have greater representation in the paleontological record, but there is no question that the smaller and more delicate types existed at the same time, and (from a food-chain argument alone) in superior numbers.

Giant or dwarf, potent or defenseless, all travel the same road of racial senescence. "Looking at evolution as it has taken place one feels driven to the conclusion that the large majority of the forms that have evolved have been failures" (Broom, 1933, p. 70). If this paleontologist had said "all eventually prove failures" he would have been nearer the mark, and in agreement with another who wrote "Given time, the fate of all species is extinction" (Reid, 1922). The facts ill comport with the alleged presence of a constant perfecting principle, a survival of the fittest, which, logically should make species immortal. The decadence and extinction of the products of evolution throw a sardonic light on postulated natural selection which if admitted as a factor at all, must be credited

with selection of failures, of ever vanishing races, a selector that permits all to descend into oblivion. In fact survival of the fittest and extinction seem diametrically opposite terms of mutually exclusive significance. If the one exists, the other does not and extinction is a fact.

In accounting for extinctions, the hypothesis of racial senescence, which is entirely compatible with survival of the ordinary and with orthogenetic doctrine, has a natural acceptability. On the other hand, explaining extinction by a process of survival of the fittest involves such a contradiction of ideas as to make it entirely unacceptable.

Darwin alluded briefly to the problem but is singularly unconvincing. His ideas may be grouped as involving extinction through transformation, through competition, and through usurpation of place. Transformation is not a natural selection phenomenon as it does not involve competition. Further it does not explain how certain lines of evolution have been totally obliterated. Competition and usurpation of place may be considered together for it is manifest that neither could have occurred in the case of numerous extinct creatures whose place has never been filled. For instance, there is no natural environmental reason why camel-like forms represented there as fossils should not now live in the desert regions of the southwestern United States. Horses, reintroduced, thrive in the wild in both North and South America on ranges where their fossil analogues abounded. Such cases convincingly indicate that the causes of extinction were internal to the organisms concerned and not external or selective. Nothing could have usurped the place of various extinct creatures that were the physical superiors of anything that lives on the earth today. No they merely finished their courses, they yielded, not to a conquering competitor nor even to environmental deficiency, but to the running down of their own vital mechanisms. It is something that comes to every individual and to every race—senescence, the unavoidable.

The question remains as to how under natural selection, postulating a process of continual preservation of favorable variations and of survival of the fittest, any line of descent could become extinct. It is a question that, except for the generalities above discussed, Darwin does not attempt to answer. Haldane's (1935) effort to help does not seem successful. He states that it is a "fallacy that natural selection will always make an organism fitter in its struggle with the environment" (p. 119) and that variations "which possess survival value for the individual may lead to degeneration and extinction of the species" (p. 162).

However these suggestions may be classed, they certainly are not good selection doctrine. Contrast with the first, Darwin's (? 1912, p. 73) assertion that "It may metaphorically be said that natural selection is daily and hourly scrutinizing, throughout the world, the slighest variations; rejecting those that are bad, preserving and adding up all that are good, silently and insensibly working, *whenever and wherever opportunity offers*, at the improvement of each organic being in relation to its organic and inorganic conditions of life."

As to the second of Haldane's ideas, it involves such a contradiction of terms as to be rejected at once. It seems obvious that "variations which possess survival value for the individual" cannot "lead to degeneration and extinction of the species," as the species can be extirpated only through the elimination of individuals and if they have variations with "survival value" they will not be eliminated.

Duerden (1920, p. 180) who evidently had some belief in natural selection said in his discussion of degenerative changes in the ostrich, "Natural selection is powerless to check permanently the relentless, degenerative influences which are at work and when the retrogressive changes have gone sufficiently far to interfere with activities essential to its existence the ostrich will disappear."

No one, as yet, has convincingly fitted selectionist doctrine to the phenomena of racial extinction and is not likely that anyone ever will. The requirements of

the situation seem to be fully met, however, by physiological explanations, all of which fall neatly in place under the general hypothesis of racial senescence.

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Careers in Physics. *Alpheus W. Smith.* Long's College Book Company. Columbus, Ohio. 1951. 271 pp. $4.00.

"Careers in Physics" is especially timely when so many young men are considering physics as a career. The author aims "to outline briefly the meaning and scope of modern physics, to indicate some of the professional activities in which physicists engage, and to give high school and college students and teachers of physics a better understanding of physics as a profession."

Contributions to the knowledge and welfare of the human race made by physics in the past leads to a discussion of promises for greater achievements in the future. The author clearly indicates the opportunities available to physicists for careers in education and industry, both in teaching and in general and specialized research. The types of work between which he must choose as an educator or industrial physicist are likewise discussed and clearly defined.

The book reviews the contributions made by physics to the many fields of science and industry, such as power, communications, illumination, etc., and points out the opportunities still available in these fields for the trained physicist.

Then follows a listing of many of the laboratories and institutes that employ physicists together with the type of work carried on at these institutions.

"Careers in Physics" is well-organized. It gives a clear exposition of the scope and meaning of physics, both classical and modern, the kind of training and the personal qualifications needed for a successful career in physics and the opportunities available for carving out a satisfying and successful career by the well-trained physicist. It should prove extremely helpful in guiding a student who is considering physics as a life work.

D. A. WOODBURY

INSECT PROBLEMS THAT DEVELOP ON ALFALFA FOLLOWING TREATMENT WITH CERTAIN INSECTICIDES[1]

M. CURTIS WILSON AND RALPH L. DAVIS
Departments of Entomology and Agronomy, Purdue University Agricultural Experiment Station, Lafayette, Indiana

Since the close of World War II many new organic insecticides have been developed and released by manufacturers. In experimental tests, many have proved to give more effective control of certain insect pests than do materials previously recommended. Others need further investigation of their effects on insects, on plants, and on man before their use can be recommended.

The indiscriminate use of many of the new organic insecticides may create more serious problems than is generally recognized. DDT had been used only a short time when investigators began reporting such strange effects as the buildup of certain insect populations, creating new problems more serious than the problem before treatment.

This was particularly true with certain aphids and mites. Serious aphid increases have been reported by Stevenson et al. (1944), Loftin (1944), Baker, Howard, and Porter (1945), Eberling (1945), Hervey (1946), Newcomer, Dean, and Carlson (1946), Wheeler and LaPlante (1946), and Sylvester (1949) following the use of DDT. Mite increases have been reported by Loftin (1944), Eberling (1945), Gray (1945), Hough (1946), Driggers (1946), Michelbacker et al. (1946), Wheeler and LaPlante (1946), and DeBach (1947). Increases in scale insects have been reported by Woglum (1946), Middlekauff et al. (1947), and Michelbacker et al. (1947). Wilson (1949) reported increased populations of potato leafhoppers, *Empoasca fabae* (Harris), following treatment with chlordane.

DDT and other new organics are not the first insecticides reported to effect an increase in the population of certain insects following their use. Folsom (1927, 1930), Dunham and Clark (1941), Smith and Fontenot (1942), and Elmore and Campbell (1943) reported aphid increases following the use of calcium arsenate, while Hill and Tate (1943) reported similar effects on aphid populations sprayed with zinc arsenite.

During the three successive years of 1948, 1949, and 1950, the authors conducted studies testing most of the new organic insecticides for possible use to control insects on alfalfa. Each year the populations of the potato leafhopper, *Empoasca fabae* (Harris), increased after treatment with chlordane, aldrin, or dieldrin. Of the three years, 1950 was the only year in which populations of pea aphid, *Macrosiphum pisi* (Kalt), were large enough in the experiments to obtain useful data. Tremendous population increases of this insect were observed on dieldrin and toxaphene plots.

DDT is very effective in controlling both the potato leafhopper and the pea aphid, and a high residual action was observed four weeks after treatment. DDT was used as a standard for comparison with untreated and insecticide treated plots on which the populations increased.

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[1]Journal paper No. 587.

METHODS

Plot size and arrangement. The following plot sizes have been used: 30 x 200 feet, 20 x 40 feet, 20 x 60 feet, and 30 x 30 feet. Treatments were replicated from 4 to 8 times in all experiments. Because certain insect populations increased following the application of some materials, a Latin-square design with eight treatments was tried to determine if the population build-up might be due to position effect.

Equipment. Materials were applied with a small experimental sprayer mounted on bicycle wheels and equipped with a 10-foot boom for legume spraying. Sprays were applied at 40 pounds pressure using CO_2 as a propellent. A speedometer was attached to the sprayer so that accurate dosages could be applied to treated plots. Insecticidal treatments were applied in July to the second alfalfa crop just prior to breaking into bloom. All alfalfa of the second crop surrounding the experimental area was cut for hay. The experimental plots were allowed to set seed.

Insect sampling. Insect populations were sampled one week and four weeks after treatment with an insect sweep net, 20 sweeps being made in each plot. The alfalfa experimental plots were always sampled for insects on warm, clear days between the hours of 10 A.M. and 3 P.M.

TABLE 1

Comparison of F values for actual data and data transformed by $\sqrt{X + 0.5}$

Insect	Experiment	Time	Calculated F. Value		Required for Significance	
			Actual Counts	Transformation	F .05	F .01
Leafhopper	1–1948	1 wk.	7.95	0.46	2.90	4.56
"	" "	4 wks.	10.71	15.78	2.90	4.56
"	2–1949	1 wk.	10.73	20.95	2.10	2.83
"	" "	4 wks.	10.48	10.46	2.10	2.83
"	3 "	1 wk.	7.13	15.38	2.24	3.10
"	" "	4 wks.	8.36	14.38	2.24	3.10
"	4–1950	1 wk.	4.33	5.83	2.15	2.94
"	" "	4 wks.	11.02	12.43	2.46	3.60
Aphid	" "	1 wk.	6.94	11.17	2.15	2.94
"	" "	4 wks.	3.56	4.11	2.46	3.60

EXPERIMENTAL RESULTS

Leafhoppers—Empoasca fabae (*Harris*)

Data first analyzed by analysis of variance showed significant leafhopper population increases on chlordane, aldrin, and dieldrin treatments. Analysis also showed that the position of the plot in the field had no significant effect on the treatment. Leafhopper populations built up regardless of the treatment location.

Because the insect counts are not normally distributed, the analysis was repeated transforming the data by $\sqrt{X + 0.5}$. This analysis increased the significance of the differences in most cases. Table 1 compares F values of the analysis from actual data with the analysis from transformed data. Since the transformation increased the significance of the differences, the original data with calculated least significant differences are included in tables 2 and 3.

Chlordane effects. Data in table 2 show that when chlordane was applied at the rate of one pound per acre, one week after treatment in experiment 1 the leafhopper population was increased, but not significantly. In experiment 2 the population was slightly, but not significantly, lower on treated than on untreated plots. In experiment 3 the population showed a trend to increase which was not

TABLE 2

Comparison of populations of E. fabae (*Harris*) *in chlordane, aldrin, and dieldrin plots with untreated and DDT treated plots; one week and four weeks after treatment.*

TREATMENT	NUMBER OF LEAFHOPPERS PER 20 SWEEPS AFTER TREATMENT							
	1948 Experiment 1		1949 Experiment 2		1949 Experiment 3		1950 Experiment 4	
	1 wk.	4 wks.	1 wk.	4 wks.	1 wk.	4 wks.	1 wk.	4 wks.
Untreated	39	113	41	86	61	108	45	189
DDT 2 lb. per acre	1	6	4	31	4	7	8	51
Chlordane 1 lb. per acre	93	353	31	130	93	78	..	..
Aldrin 0.5 lb. per acre	..	..	..	..	144	253	..	..
Dieldrin 0.5 lb. per acre	..	..	43	132	..	..	39	517
L. S. D. .05	non. sig.	127	14	35	52	81	19	135
" .01	non. sig.	175	19	47	69	109	26	185

FIGURE 1. Comparison of percent increase of *E. fabae* due to chlordane, aldrin, or dieldrin with percent decrease due to DDT based on untreated plots.

significant one week after treatment. Four weeks after treatment, the leafhoppers in experiments 1 and 2 showed a tremendous population build-up.

Dieldrin effects. When dieldrin was applied at the rate of one-half pound per acre, two experiments showed no increase in population one week after treatment. However, four weeks after treatment, the leafhopper population increase in both experiments was very large.

Aldrin effects. Aldrin was tested in only one experiment. This one experiment indicated that the population build-up with aldrin at the rate of one-half pound per acre was more rapid than either with chlordane at the one pound rate or with dieldrin at the one-half pound rate. Within one week aldrin plots reached a much higher population build-up than either chlordane or dieldrin plots. Also, the only experiment where chlordane did not cause a population increase was experiment 3 in which the increases in the aldrin plots were so high.

Data on leafhoppers from all experiments were averaged and the percentage change in populations calculated. The data are presented in figure 1.

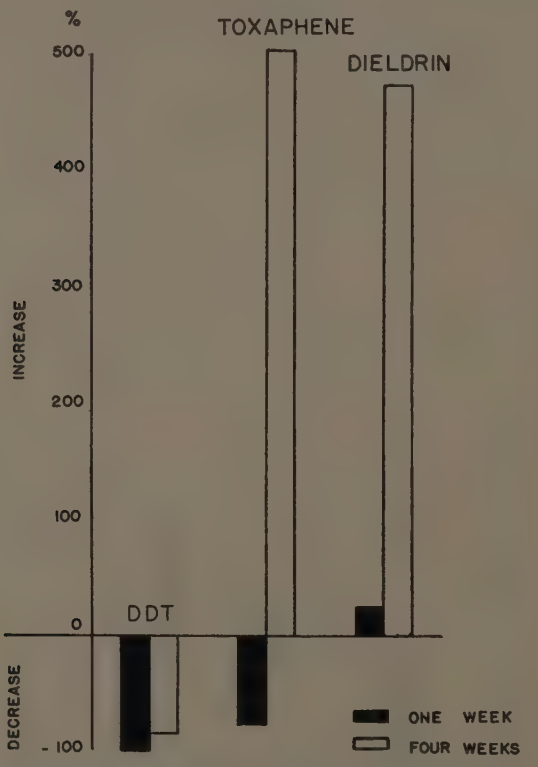

FIGURE 2. Comparison of percent increase of *M. pisi* due to dieldrin or toxaphene with percent decrease due to DDT based on untreated plots.

Aphids—Macrosiphum pisi (*Kalt.*)

Sufficient aphid populations to obtain adequate data developed only in the 1950 season. The F values for actual data and transformed data are included in table 1. In each case significance of the data was increased when the data were analyzed using the $\sqrt{X + 0.5}$ transformation.

In table 3 original data tabulated from population counts of the pea aphid, *Macrosiphum pisi* (Kalt), are included together with the calculated differences required for significance. These data are presented as a preliminary report showing possible trends from the use of certain insecticides on this insect. Although DDT does not control many species of aphids, it is highly effective against the pea aphid. In table 3, the effects of toxaphene and dieldrin are compared with the highly effective residual effect of DDT. Toxaphene effected significant control of the aphid one week after treatment at a dosage of three pounds per acre. However, four weeks after treatment surviving aphids built up their population 518 percent. A dosage of one-half pound of dieldrin showed an increased population trend under significance the first week, but a significant 466 percent increase four weeks later. These data are presented in figure 2.

TABLE 3

Comparison of populations of M. pisi (*Kalt.*) *in dieldrin and toxaphene plots with untreated and DDT treated plots; one week and four weeks after treatment.*

TREATMENT	NUMBER OF APHIDS PER 20 SWEEPS	
	1 week	4 weeks
Untreated	116	53
DDT		
2 lb. per acre	6	9
Toxaphene		
3 lb. per acre	32	330
Dieldrin		
0.5 lb. per acre	133	302
L. S. D. .05	55	185
" .01	74	254

SUMMARY

In conjunction with studies on the control of alfalfa insects, observations were made which showed that certain insect populations instead of being reduced by certain insecticides may be increased in numbers. Three field experiments showed that populations of the potato leafhopper, *Empoasca fabae* (Harris), may increase following treatment with per acre dosages of one pound of chlordane, one-half pound of aldrin, or one-half pound of dieldrin. Similar effects were noted in 1950 to occur to populations of the pea aphid, *Macrosiphum pisi* (Kalt.), following treatment with one-half pound of dieldrin or 3 pounds of toxaphene.

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Genetics in the 20th Century. *L. C. Dunn*, Ed. The Macmillan Co. New York. 1951. xi+634 pp. $5.00.

This book is a collection of the invitation papers presented at the program of the Golden Jubilee of Genetics at Ohio State University in September, 1950. The series of 26 essays covers the progress of genetics during its first fifty years following the rediscovery of Mendel's work in 1900. The introductory paper by Goldschmidt discusses the impact of genetics on the other sciences. In the following papers the subjects treated include the life of Mendel, genetics before 1900, the early development of genetics in America after 1900, the development of the gene theory, and the development and current status of research in biometrical genetics, cytogenetics, physiological genetics, human genetics, animal and plant breeding, and population genetics. The authors are in most cases the outstanding contributions to their particular fields.

The book should prove of value to geneticists anxious to keep abreast of developments in special fields other than their own. In addition the treatment is general enough for the most part to make the book useful to non-geneticists who wish to know the directions which research is taking in this most central of the biological sciences.

MARGARET C. GREEN

NEW SPECIES OF NORTH AMERICAN BUPRESTIDAE
(COLEOPTERA)

JOSEF N. KNULL
Department of Zoology and Entomology, The Ohio State University, Columbus 10

In a study of North American Buprestidae the following new species have come to my attention. Type material in collection of author unless stated otherwise.

Acmaeodera hualpaiana n. sp.

Figure 5

♂.—Short, rather robust, shining; head, pronotum and ventral surface black with bronze reflection, elytra very dark brown with scattered yellow markings as follows: five along side margin and four in median line of each elytron.

Head convex; surface irregularly finely punctate, front densely pubescent; clypeus deeply emarginate; antennae serrate starting with fifth segment.

Pronotum much wider than long, widest in middle; sides broadly rounded; anterior margin sinuate, median lobe broad; basal margin truncate; disk convex with slight median depression and strong basal depression on each side; surface with large, light punctures, more evident toward sides, narrow line of perpendicular striations extending across base; clothed with long recumbent white pubescence.

Elytra at base wider than base of pronotum; sides constricted back of base, expanded to subparallel sides and rounded to separately rounded apices, serrulate back of middle; disk convex, umbone prominent, basal depressions shallow; surface with rows of closely placed punctures forming striae at base and apex, interspaces with single rows of short semierect sharp-pointed hairs.

Ventral surface densely clothed with divided squamae and in addition more widely separated semierect longer hairs on abdomen. Anterior margin of prosternum sinuate with median truncate lobe, margin not touching lateral prolonged angles at sides, but extending nearly as far front.

Length 5.4 mm; width 1.8 mm.

♀.—Slightly more robust; last three ventral segments densely pubescent with long incurved hairs; fourth segment with spine each side near anterior margin.

Holotype ♂ labeled Hualpai Mountains, Ariz., July 4, 1937; allotype Wickenburg, Ariz., June 16, 1937. Paratypes as follows: Gila Mountains, Yuma Co., Ariz., June 16, 1941; Wickenburg, Ariz., June 29, 1939; Holtville, Calif., June 6, 1951 and Palm Springs, Riverside Co., Calif., May 19, 1941. All material collected by D. J. & J. N. Knull.

Superficially this species resembles *A. varipilis* Van D. It may be distinguished by its short, more robust form, wider more finely sculptured pronotum and by the median truncate lobe of front margin of prosternum. This margin varies in some of the specimens, however the tooth on each side is much smaller than in *varipilis*.

Acmaeodera chisosensis n. sp.

Figure 1

♂.—Size and form of *A. hulli* Knull, more shining; both surfaces dark bronze, head and pronotum slightly more brilliant; each elytron with three yellow markings, one at middle and two back of middle.

Head convex, densely finely punctured, sparsely pubescent; clypeus deeply emarginate; antennae serrate starting with the fifth segment.

Pronotum wider than long, widest about middle; sides broadly rounded; anterior margin sinuate, median lobe feeble; basal margin truncate; disk convex, a small deep pit on each side at base; surface densely coarsely punctured, punctures large and closer on sides, base margined with line of perpendicular striations; long white pubescence sparse in middle, more dense toward sides.

Elytra wider than pronotum at base; sides constricted in front of middle, subparallel back of middle, broadly rounded to suture, serrulate from middle; disk convex, umbones prominent,

basal depressions light; surface striately punctured, each interspace with a line of smaller punctures and each containing a short sharp pointed hair; divided white scales at sides in front.

Ventral surface densely clothed with divided squamae, longer hairs in middle of abdominal segments. Anterior margin of prosternum strongly sinuate, with prominent tooth on each side, margin not touching lateral prolonged angles at sides, but extending nearly as far front.

Length 5.5 mm; width 1.8 mm.

♀.—More robust, last three ventral segments densely pubescent with long incurved hairs.

Holotype ♂, allotype and paratypes from Chisos Mountains, Brewster Co., Texas, July 17, 1946 and paratypes from same locality, June 9, 1939, D. J. and J. N. Knull collectors. Two paratypes from same locality, July 24 and 25, H. A. Wenzel collector in H. W. Wenzel collection, The Ohio State University and one labeled Big Bend, Texas, June 24, 1947, R. H. Beamer in The University of Kansas collection.

Variations.—Sizes vary from 5.5 to 7.3 mm in length and from 1.8 to 2.6 mm in width. The elytra of some specimens have a bluish reflection.

This species should stand next to *A. hulli* Knull. It differs in its more shining appearance and by the pointed hairs of elytral intervals instead of the spatulate type. It is not as elongate as *A. varipilis* Van D., pronotum less coarsely sculptured and only one row of yellow elytral markings instead of two rows.

Melanophila (Phaenops) obenbergeri n. sp.

Figure 2

♀.—Subcylindrical, elongate; head and pronotum bronze, elytra darker; ventral surface about color of head and pronotum.

Head convex; coarsely irregularly punctured around eyes and in clypeal region, rest of surface coarsely strigate; clypeus broadly emarginate; antenna reaching past middle of pronotum when laid along side; third segment as long as scape, fourth shorter than third, fifth longer than second; outer segments gradually diminishing in length.

Pronotum wider than long, widest back of middle, wider at base than at apex; lateral margin not obliterated in front; sides broadly rounded; anterior margin slightly sinuate with broad median lobe; basal margin strongly sinuate; disk convex; surface densely coarsely punctured, punctures shallow. Scutellum oval, wider than long.

Elytra at base wider than pronotum, widest back of middle; sides divergent in front, constricted in front of middle, widened back of middle; apices separately rounded; margin serrulate in apical third; disk convex with humeral depression each side; surface imbricate, pubescence short.

Entire ventral surface coarsely punctured. Posterior tarsus slightly shorter than tibia; first segment longest, rest of segments diminishing in length.

Length 8.6 mm; width 3.2 mm.

Holotype ♀ labeled Fayette Co., Tex., July 30.

This species would stand next to *M.* (*Phaenops*) *obtusa* Horn. It is larger, elytra less coarsely sculptured with longer pubescence, pronotum with side margin not inferior in front as in *obtusa*. From *M.* (*P.*) *intrusa* Horn it differs in coarser elytral sculpture, less pubescence and in having entire side margin of pronotum.

I take pleasure in naming this species for Dr. Jan Obenberger.

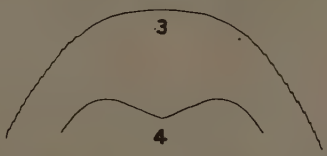
EXPLANATION OF FIGURES

1. *Acmaeodera chisosensis* n. sp., ♂.
2. *Melanophila obenbergeri* n. sp., ♀.
3. Last visible sternite of *Chrysobothris vivida* n. sp., ♀.
4. Clypeal emargination of *Chrysobothris vivida* n. sp., ♀.
5. *Acmaeodera hualpaiana* n. sp., ♂.
6. Genitalia of *Agrilus mojavei* n. sp., ♂, dorsal view.
7. Ventral view of number 6.

Line equals 1 mm.

1

2



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4

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6 7

J.N.K.

Chrysobothris vivida n. sp.

Figures 3, 4

♀.—Size, form and color of *C. humilis* Horn. Short, robust; metallic green above and below, antennae and feet darker with greenish reflection.

Head convex; surface coarsely punctured, two chitinized smooth areas on each side on front; pubescence sparse, short; clypeus deeply emarginate; antennae short, reaching to middle of pronotum.

Pronotum much wider than long, widest in middle; sides evenly rounded from base to apex; anterior margin sinuate, median lobe broad; basal margin sinuate, median lobe rounded; disk convex, without callosities or median depression; surface deeply, coarsely punctured, punctures closer at sides, pubescence more evident toward sides. Scutellum large, triangular, depressed in middle.

Elytra at base wider than widest part of pronotum; sides constricted back of base, expanded back of middle, rounded apically to separately rounded apices, margins serrulate; disk convex, without costae, basal depressions deep; surface coarsely, densely punctured, punctures becoming smaller toward apices, pubescence sparse, short.

Abdomen beneath strongly convex, densely coarsely punctate, pubescence long, but not dense; anterior margin of last two sternites smooth, lateral callosities present on all segments, last visible sternite broadly rounded, margins finely serrate. Prosternum finely punctate, margin without lobe. Anterior femur with tooth.

Length 5.9 mm; width 2.5 mm.

♀ holotype labeled Scott Co., Kansas, June 21, 1925.

This species should stand next to *C. ephedrae* Knull. It can be distinguished by the color and coarser dorsal sculpture. It undoubtedly stands in collections under *C. humilis* Horn from which it can be separated by lack of prosternal lobe.

Agrilus mojavei n. sp.

Figures 6, 7

♂.—Form of *A. fisheriana* Knull; shining bronze in color; dense white pubescence as follows: on front, along prehumeral carinae and in lateral depressions of pronotum; in basal depression, in middle and back of middle on each elytron, on most of ventral surface all but middle of ventral abdominal segments; pubescence of dorsal surface prominent.

Head convex, slight median depression extending from vertex to middle of front; surface finely irregularly punctured, sculpture concealed by long pubescence on front; antennae serrate from fourth segment.

Pronotum wider than long, wider in front than at base, widest about middle; sides subparallel in front, strongly rounded to base; anterior margin sinuate, median lobe prominent; basal margin trisinuate, median lobe truncate; disk convex, median depression in front of scutellum and back of front margin, small depression each side of anterior median depression, lateral depressions deep, prehumeral carinae well indicated; surface finely obliquely rugose. Scutellum transversely carinate.

Elytra wider than base of pronotum; sides subparallel in front, constricted about middle, broadly rounded posteriorly to rounded serrulate apices; disk with a longitudinal costa on each elytron, also with deep basal depression, shallower depression at middle and back of middle, depressions clothed with long white pubescence; surface imbricate.

Prosternal lobe broadly rounded with deep emargination in middle. Abdomen beneath densely finely punctured at sides, punctures sparser in middle; first segment flattened at middle; second segment with smooth deep median excavation; pygidium with a projecting carina. Anterior and middle tibiae armed with an obtuse tooth on inside at apices. Tarsal claws similar, cleft, inner tooth stouter than outer, slightly turned inward, tips distant.

Length 8 mm; width 2.2 mm.

Described from one ♂ specimen collected on poplar at Oro Grande, San Bernardino Co., Calif., June 20, 1951 by D. J. and J. N. Knull.

This species should stand next to *A. fisheriana* Knull. It differs by being more robust and lacks the line of pubescence along suture.

STUDIES OF THE GENUS KUNZEANA. III. NEW SPECIES OF MEXICAN KUNZEANA

ROBERT F. RUPPEL AND DWIGHT M. DELONG
Department of Zoology and Entomology, The Ohio State University, Columbus 10

Thirteen Mexican species have previously been described in this genus in Parts I and II (Ruppel and DeLong, 1951, 1952). The present treatment contains descriptions of eight new species and a redescription of *rosea* (Osborn) which cannot be identified or separated from closely related species by the original description and was determined only by an examination of the type material in the Carnegie Museum. It is illustrated here to assist others in recognizing it.

This group of species has more bizarre aedeagi or more elaborate or elongated accessory processes than any of the species of the genus which have been studied to date and most of these processes arise basally.

The types of all species are in the DeLong collection.

Kunzeana usitata n. sp.

Resembling *kunzei* (Gillette) in form and general appearance but smaller and with distinctive genitalia. Length 2.5 mm.

The vertex is produced about one-half of its length in front of the eyes, its anterior margin is broadly rounded, and its median length is slightly less than its basal width between the eyes.

Color: The vertex is cream mottled with heavy, orange markings. The anterior margin of the vertex is bordered with a broad ivory band. The face is dusky orange with the genae and lorae light cream. The pronotum is golden orange with its anterior margin bordered with an ivory band which is spotted with orange markings. The scutellum is ivory with its apex, basal angles, and a pair of short, median, longitudinal lines, orange. The elytra are translucent bright golden yellow with a stripe along their claval sutures and their apices, semihyaline.

Genitalia: The pygofers, plates, and styles of the male are similar to those of *kunzei*. The thick, straight, bluntly-pointed pygofer hooks arise on the dorso-caudal angle of the pygofer and extend caudad. The base of the aedeagus is rather long and broad with its dorsal processes rather long and thick. The phalicata is short and recurved with its lateral margins extended into wing-like flaps which extend laterad and terminate in pointed apices near the distal third of the phalicata. Holotype male collected at Cocula, G'ro., Aug. 6, 1930 (M. F. 1753) by J. Parra.

Kunzeana raia n. sp.

Resembling *usitata* in form and general appearance but larger and with distinctive genitalia. Length 2.75 mm.

The vertex is produced for about one-half of its length in front of the eyes, its anterior margin is broadly rounded, and its median length is slightly less than its basal width between the eyes.

Color: The vertex is cream, bordered anteriorly with an ivory band. The disk of the vertex is heavily mottled with orange. The face is dull orange with the lorae and genae cream. The pronotum is bright greenish yellow with its anterior margin bordered with an ivory band which is spotted with orange markings. The scutellum is cream with its basal angles and apex dull orange. The elytra are bright yellow with a stripe along each claval suture and their apical cells semi-hyaline.

Genitalia: The pygofers, plates, and styles of the male are similar to those of *usitata*. The base of the aedeagus is short and rather broad with its dorsal processes long and slender. The phalicata is rather thin and its lateral margins are extended into flat wings which curl somewhat dorsad and terminate in rounded apices near the middle of the phalicata. The pygofer hooks arise on the dorso-caudad angle of the pygofer and are recurved and sharply pointed.

Holotype male and male paratypes collected at Iguala, G'ro., Sept. 11, 1939, by D. M. DeLong; male paratype collected at Iguala, G'ro., Oct. 25, 1941, by DeLong, Good, Caldwell,

and Plummer; male paratypes collected at Chilpancingo, G'ro., Oct. 25, 1941, by the same collectors; male paratype collected at Carrizal, V. C., Aug. 6, 1932 (M. F. 2658) by R. R. Soto.

Kunzeana rosae (Osborn)

Dikraneura (Hyloidea) *rosae* Osborn. Ann. Carnegie Mus. 18: 278, 1928.

Resembling *kunzei* (Gillette) in general form and appearance but with a longer, sharper head than *kunzei* and with distinctive coloration and genitalia. Length 2.5 mm.

The vertex is produced for about one-half of its length in front of the eyes, it is sharply angled at the apex, and its median length is equal to its basal width between the eyes. The body is somewhat depressed and the face recedes sharply from the vertex.

Color: The vertex is reddish tan bordered anteriorly with a cream band and flecked on its disk with creamy spots. The face is dull tan with the genae and lorae cream. The pronotum is dull brown with its anterior margin reddish and spotted with cream markings. The scutellum is dull orange. The elytra are bright, deep yellow with their apices semi-hyaline.

Genitalia: The posterior margin of the seventh abdominal sternite of the female is nearly truncate with its median quarter abruptly produced into a short rounded lobe. The pygofers, plates, and styles of the male are similar to those of *kunzei*. The pygofer hooks arise on the dorso caudal angle of the pygofer and are rather slender and sharply pointed. The base of the aedeagus is rather short and broad with its dorsal processes short and broadly separated at their apices. The phallicata is thin, and broad with its lateral margin produced into boot-shaped, hyaline processes near its distal third.

Mexican specimens have been collected at Iguala, G'ro., Sept. 11, 1939, by D. M. DeLong and C. C. Plummer and Oct. 25, 1941, by DeLong and Good; others were collected at Huitziltepic, G'ro., Nov. 20, 1929 (M. F. 1546) by Dr. Dampf.

Kunzeana parrai n. sp.

Resembling *rosea* (Osb.) in form and general appearance but with the vertex more sharply angled at its apex and with distinctive coloration and genitalia. Length 2.7 mm.

The vertex is produced for about one-half of its length in front of the eyes, it is sharply pointed at its apex, and its median length is almost equal to its basal width between the eyes. The body is somewhat depressed and the face recedes sharply from the vertex.

Color: The vertex is dull orange bordered anteriorly with a cream band and spotted on its disk with obscure cream spots. The face is a uniform rich black. The pronotum is orange brown bordered anteriorly with a dull orange band which bears a few cream spots. The scutellum is dull orange. The elytra are golden orange with a stripe along each claval suture and the first and fourth apical cells, semi-hyaline.

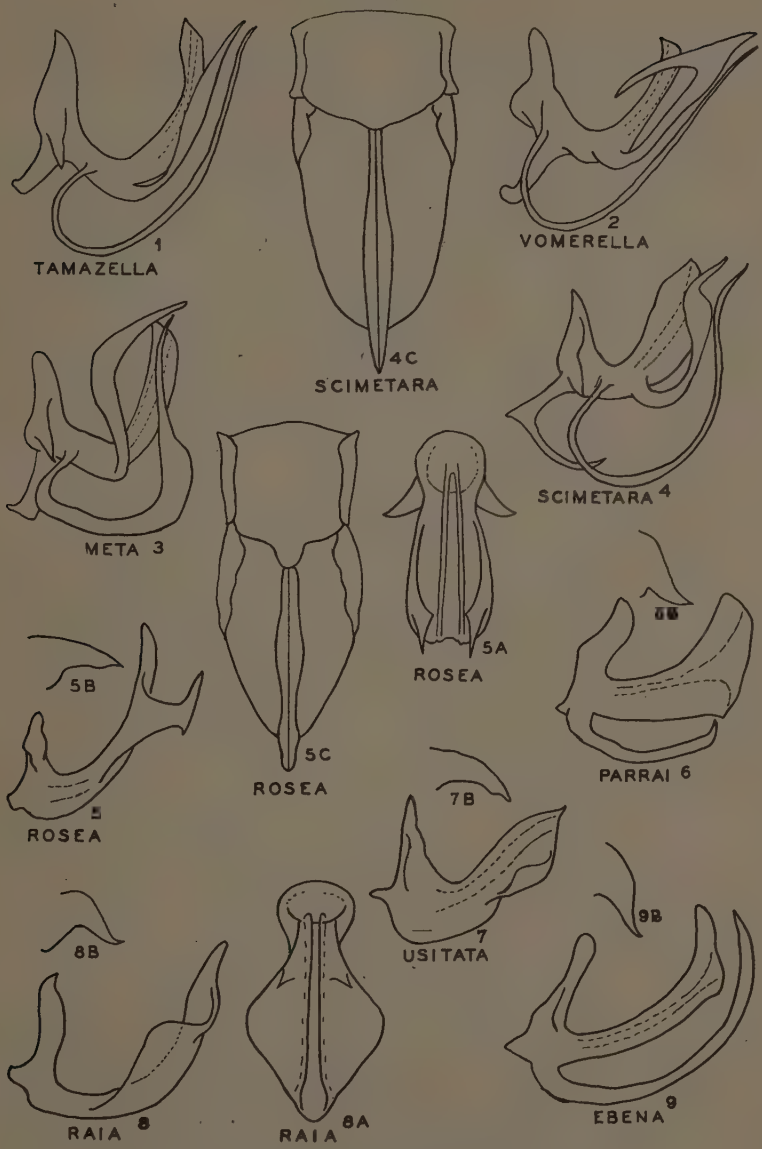
Genitalia: The pygofers, plates, and styles are similar to those of *rosea*. The pygofer hooks arise on the dorso caudal angles of the pygofers and are slightly recurved and sharply pointed. The base of the aedeagus is short with its dorsal processes short and sharp at their apices. A pair of ventro-lateral processes, equal in length to the phallicata, arise on the base of the aedeagus and extend caudad. The phallicata widens toward its apex, its width at the apex being about three times its width at the base.

Holotype male collected at Balsas, G'ro., Nov. 12, 1929 (M. F. 1501) by Dr. Dampf; paratype males collected at Tierra Colorada, G'ro., July 12, 1929 (M. F. 1534) by Dampf; Pungarabato, G'ro., Aug. 22, 1930 (M. F. 1763) by J. Parra; Arcelia G'ro., Aug. 17, 1930 (M. F. 1766) by J. Parra; and Iguala, G'ro., Sept. 11, 1939, by D. M. DeLong.

Kunzeana ebena n. sp.

Resembling *parrai* in form and general appearance but differing in male genitalia. Length 2.7 to 3 mm.

Vertex produced about one half of its length in front of the eyes with its median length equal to its basal width between the eyes. The body is slightly depressed and its face recedes sharply from the vertex. The shape of the vertex in the series at hand varies from pointed to somewhat rounded at the apex.



1, 2, 3, 4, 5, 6, 7, 8, 9—aedeagus (lateral view).
5a, 8a—aedeagus (ventral view).
5b, 6b, 7b, 8b, 9b—pygofer hook (lateral view).
4c, 5c—female seventh sternite and pygofers.

Color: The coloration in the series at hand varies from a nearly uniform reddish orange to a mottled, golden yellow. The vertex is reddish orange bordered anteriorly by an ivory band and flecked with obscure cream spots on its disk. The face is a uniform, rich black. The pronotum is orange-brown bordered anteriorly by a dull orange band which bears a few cream spots. The scutellum is dull orange. The elytra are yellow to reddish orange with their apices hyaline.

Genitalia: The pygofers, plates, and styles of the male are similar to those of *parrai*. The base of the aedeagus is rather long with its dorsal processes long and slender. A pair of thin ventro-lateral processes, slightly longer than the phalicata, arise at the base of the aedeagus. The phalicata is moderately slender to near its distal quarter where it flares to make the phalicata about twice as wide at its apex than it is at the base.

Holotype male and male paratypes collected at Valles, S. L. P., Sept. 24, 1941, by DeLong, Good, and Caldwell; male paratypes, Iguala, G'ro., Sept. 11, 1939, by D. M. DeLong, and Oct. 25, 1941, by DeLong and Good; male paratypes, Paso de Vacas, G'ro., Sept. 3, 1930 (M. F. 1792) by J. Parra; male paratypes, Mezcala, G'ro., Nov. 13, 1929 (M. G. 1512) by Dr. Dampf; male paratypes, Zirandarao, G'ro., Aug. 29, 1930 (M. F. 1786) by J. Parra; male paratypes, Cutzamala, G'ro., Aug. 20, 1930 (M. F. 1768) by J. Parra; male paratype, Cocula, G'ro., Aug. 6, 1930 (M. F. 1753) by J. Parra; male paratype, Yetla, G'ro., Aug. 11, 1930 (M. F. 1756) by Parra; male paratype, Balsas, G'ro., Aug. 15, 1930 (M. F. 1754) by J. Parra; male paratype, Arcelia, G'ro., Aug. 17, 1930 (M. F. 1766) by J. Parra; male paratype, San Geronimo, G'ro., Aug. 30, 1930 (M. F. 1787) by J. Parra.

Kunzeana meta n. sp.

Resembling *aurulenta* in general appearance but with a longer, more sharply pointed head and with distinctive genitalia. Length 2.4 mm.

The vertex is produced two-thirds of its length in front of the eyes, it is sharply angled at its apex, and its median length is slightly greater than its basal width between the eyes.

Color: The vertex is golden tan with its anterior margin ivory and with a median longitudinal line and a short, longitudinal line on each side of its disk, light cream. The face is light golden tan. The pronotum is light yellow bordered anteriorly with an irregular ivory band. The scutellum is ivory with its apex, basal angles, and a pair of median, longitudinal, lines light orange. The elytra are light yellow with most of each clavus and their distal halves, semi-hyaline.

Genitalia: The plates, styles, pygofers, and pygofer hooks of the male are similar to those of *aurulenta*. The base of the aedeagus is narrow, ring-shaped, with each of its dorsal processes bearing sharpened, dorsal, and ventral projections. The phalicata is nearly parallel sided, obliquely truncate at its apex, and bears two pair of processes; a basal, lateral, clavate pair, and a pair of more distal, lanceolate, ventro-lateral processes reflexed over the phalicata. The basal processes widen to near their distal third where they narrow abruptly, terminating in whip-like apices. Holotype male and male paratype collected at Tamazunchale, S. L. P., Sept. 25, 1941, by DeLong, Good and Caldwell.

Kunzeana scimetara n. sp.

Resembling *aurulenta* in general appearance but with the vertex more sharply angled at its apex and with distinctive male genitalia. Length 2.5 mm.

The vertex is strongly produced and sharply angled at its apex with its median length equal to the basal width between the eyes.

Color: The vertex is cream on the disk with its anterior margin broadly bordered with an ivory band. A light orange band, irregular on its posterior margin, extends between the ivory anterior band and the cream disk of the vertex. The face is light tan with its genae and lorae, cream. The pronotum is golden yellow, semi-hyaline on its posterior margin, and bordered anteriorly with an ivory band which bears some elongate, light orange spots. The scutellum is cream with a pair of longitudinal, median lines, its apex and its basal angles orange. The elytra are golden yellow with the margins of the clavus, the distal portion of the costal margin, and the apical cells, semi-hyaline.

Genitalia: The plates, styles, pygofers, and pygofer hooks of the male are similar to those

of *aurulenta*. The base of the aedeagus is narrow and ring-shaped and bears a short, slender, caudally-directed ventral process. Each dorsal process of the base has sharpened, dorsal and ventral projections. The phalicata is broad, widening slightly to near its apical quarter where it narrows suddenly to a pointed apex. Two pair of processes are borne on the phalicata; a pair of long, slender lateral processes which curve ventrad and then dorsad and extend to the apex of the phalicata, and a pair of clavate, ventro-lateral processes which extend parallel to the phalicata to near its apex. Both pairs of processes are reflexed at their apices. The posterior margin of the seventh abdominal sternite of the female is slightly produced into a blunt lobe.

Holotype male and paratype males collected at Balsas, G'ro., Dec. 11, 1929 (M. F. 1501) by Dr. Dampf; allotype female and male paratypes, Valles, S. L. P., Sept. 24, 1941, by DeLong, Good and Caldwell; male paratypes from Mezcala, G'ro., Dec. 13, 1929 (M. F. 1512) by J. Parra; Cocula, G'ro., Aug. 6, 1930 (M. F. 1753) by Dampf; Iguala, G'ro., Sept. 11, 1939, by DeLong; Lake Peten, Guat., Nov. 12, 1925 (M. F. 794) by Dampf.

Kunzeana tamazella n. sp.

Resembling *scimetara* in general form and appearance but with distinctive genitalia. Length 2.5 mm.

The vertex is sharply angled at its apex and its median length is as great as its basal width between the eyes.

Color: The vertex is golden tan bordered anteriorly with an ivory band and marked on its disk with obscure cream spots. The face is pale tan with its genae and lorae cream. The pronotum is pale yellow marked along its anterior margin with scattered ivory spots. The scutellum is ivory with its apex, basal angles, and a pair of median longitudinal lines, orange-yellow. The elytra are bright yellow with a stripe along the claval suture, a stripe between the sectors, and their apical cells, semi-hyaline.

Genitalia: The plates, styles, and pygofers of the male are similar to those of *scimetara*. The base of the aedeagus is ring-like and its dorsal processes are similar to those of *scimetara*. The phalicata bears two pair of processes, a basal, lateral pair and a more distal, ventro-lateral pair. The basal pair are long, thin, curved, extend to the apex of the phalicata, and are reflexed at their apices. The more distal pair are lanceolate and extend parallel to the phalicata to near its apex. Holotype male and male paratype collected at Tamazunchale, Mex., Nov. 15, 1938, by J. S. Caldwell; male paratypes, Iguala, G'ro., Sept. 11, 1939, by D. M. DeLong.

Kunzeana vomerella n. sp.

Resembling *scimetara* in general form and appearance but with distinctive genitalia. Length 2.5 mm.

The vertex is bluntly angled at its apex and its median length is as great as its basal width between the eyes.

Color: The vertex is golden tan bordered anteriorly with an ivory band and bearing a median and a pair of lateral, parallel, longitudinal cream stripes on its disk. The face is golden with its genae and lorae dull cream. The pronotum is golden, bordered anteriorly with an ivory band which bears scattered, longitudinal, elongate, dull orange spots. The scutellum is ivory with its apex, basal angles, and a pair of median, longitudinal stripes, dull orange. The elytra are orage-yellow with their apices pale yellow.

Genitalia: The plates, styles, pygofers, and pygofer hooks of the male are similar to those of *scimetara*. The base of the aedeagus is ring-like with its dorsal processes like those of *scimetara*. The phalicata bears two pair of processes. The more basal of these are long, slim, curved, and extend to the apex of the phalicata. The more distal pair extend dorso-caudad to near their center where they turn abruptly cephalad.

Holotype male collected at Monte Alto, V. Cruz, July 3, 1932 (M. F. 2640) by Dr. Dampf; paratype male, Iguala, G'ro., Oct. 25, 1941, by DeLong and Good.

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TWO NEW SPECIES OF NORTH AMERICAN BRACHYS
(COLEOPTERA: BUPRESTIDAE)

JOSEF N. KNULL
Department of Zoology and Entomology, The Ohio State University, Columbus 10

In working over genus *Brachys* the two following new species have been found. Type material in collection of author.

Brachys querci n. sp.

Figures 1, 2

Male. Form, size, color and markings similar to *B. barberi* Fisher (1924). Dorsal surface cupreous, elytra more brilliant than head and pronotum; ventral surface dark bronze; three rather irregular transverse bands of recumbent white pubescence on elytra.

Head convex, with deep median depression extending down front; clypeus deeply emarginate; surface irregularly minutely punctate, white recumbent pubescence scattered, more dense near epistoma.

FIGURE 1. Dorsal view of ♂ genitalia of *Brachys querci* n. sp.
FIGURE 2. Ventral view of number 1.

Pronotum wider than long, widest at base, constricted at apex; anterior margin nearly truncate; basal margin sinuate, median lobe slightly emarginate in front of scutellum; disk convex, with basal transverse depression which continues down each side, prehumeral carina obtuse; surface with round glabrous area each side of median line in middle, punctures irregular, minute, recumbent white pubescence scattered. Scutellum triangular, wider than long, glabrous.

Elytra wider than base of pronotum, sides strongly constricted back of base, expanded back of middle, then convergent to rounded, minutely serrulate apices; disk convex, with deep basal depression each side at middle of each elytron, umbone prominent, lateral carina extending from base to near apex; surface rather coarsely punctate near base, punctures of rest of area minute, scattered, each bearing a short white hair, forming three rather irregular transverse bands, areas between bands smooth.

Abdomen sparsely, finely punctate and pubescent; apex of last ventral abdominal segment broadly rounded, minutely serrate, suture rounded.

Length 3.6 mm; width 1.7 mm.

Female.—Similar to male, last abdominal segment truncate; apical margin strongly dentate, suture truncate.

Variation.—Sizes vary from 3.3 to 3.6 mm in length and 1.5 to 2.1 mm in width.

Holotype ♂ and allotype taken from oak foliage in the Davis Mountains, Texas, May 9, 1941. Paratypes in same locality May 9 to July 17 and in the Chisos Mountains, Texas, July 17, 1946. All material collected by D. J. & J. N. Knull.

This species should stand next to *B. barberi* Fisher, which it resembles very closely. It was collected with *barberi* in both localities at the same time. The basal transverse depression on *querci* will separate it from the above species. The last ventral abdominal segment is more broadly rounded in the males of *barberi* and the genitalia are quite different as figured by Cazier (1951). The last ventral segment of ♀ *barberi* is more broadly rounded and the suture is sinuate. The ♂ genitalia will separate it from *B. marialicae* Caz.

Brachys apachei n. sp.

Female.—Size and form of *B. cephalicus* Schaeffer (1909), longer than broad, cuneate posteriorly, dorsal surface cupreous, with two bluish spots on each elytron; beneath dark bronze; head and pronotum with white and golden recumbent pubescence; elytra with three irregular transverse bands of white and golden pubescence.

Head convex, with deep median depression extending down front, a transverse depression about middle of front; clypeal emargination deep; surface irregularly minutely punctate, pubescence white below, golden above, sparse.

Pronotum wider than long, widest at base, constricted at apex; anterior margin nearly truncate; basal margin sinuate, median lobe emarginate in front of scutellum; disk convex, with strong lateral depression each side, prehumeral carinae obtuse; surface with round glabrous area each side of median line, punctures on rest of area minute, white and golden pubescence sparse. Scutellum triangular, wider than long, glabrous.

Elytra wider than base of pronotum; sides strongly constricted back of base, expanded back of middle, then strongly converging to broadly rounded, minutely serrulate apices; disk convex, with deep basal depression each side at middle of each elytron, umbone prominent, a lateral carina extending from base to near apex; surface sparsely, irregularly, lightly punctate with three transverse patches of white and golden pubescence separated by glabrous areas.

Abdomen sparsely, finely punctate, pubescence short, sparse; apex of last ventral abdominal segment truncate, margin strongly dentate, suture truncate, with a row of longer hairs along front margin.

Length 4 mm; width 1.9 mm.

Holotype ♀ and paratype labeled Chiricahua Mountains, Ariz., June 17, 1939, collected from oak foliage by D. J. & J. N. Knull.

This species should stand next to *B. cephalicus* Schaeffer. It can be separated by lack of strongly convex tubercles above eyes. The markings are similar to those of *B. aeruginosus* Gory, from which it can be separated by the retracted front and elongate form.

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SPREAD OF THE JAPANESE BEETLE INTO PORTAGE COUNTY, OHIO

RALPH W. DEXTER
Department of Biology, Kent State University, Kent, Ohio

The introduction, spread, and distribution of the Japanese beetle (*Popillia japonica* Newm.) in Ohio have been described by Polivka (1948, 1950). Locations of all known records are mapped and tabulated, but no record of this insect pest is given from Portage County in Northeastern Ohio. It is surprising that this county should escape infestation longer than all of the surrounding counties since it is situated near the middle of the greatest concentration of the beetle in the state. A beetle trap set on the campus of Kent State University in the summer of 1941 failed to obtain any specimens. During the past four years, however, a number of specimens collected within the city of Kent in Portage County have come to the attention of the writer. To date it is the only locality in the county where this species is known to occur.

On August 15, 1948, a single specimen of the Japanese beetle was collected from a rose bush on the west side of the city by Mr. Ladd Heldenbrand, a student in a class of field zoology. On July 14 of the following year another student, Ernest Port, collected after a careful search another single specimen from a lawn near the original discovery. That summer five beetle traps were operated in this neighborhood under the direction of Dr. J. B. Polivka. Twenty-two specimens were captured. In August two students found one beetle each while collecting with the field zoology class on the campus of Kent State University. On August 7 Miss Ann Horwarth found one of them behind Engleman Hall, and eleven days later Mr. John Brough collected the other one from a pasture at the eastern edge of the campus. That same month Mr. William Jeffers captured two beetles from about 10 specimens seen on two willow trees approximately one-half mile north of the campus. Signs of leaf-feeding were noticeable.

In the summer of 1950 the writer examined the vegetation in all of the areas listed above without finding any Japanese beetles. A beetle trap set near the middle of the city for one week did not attract any. Three professors of Kent State University, however, found specimens on rose bushes in their gardens. Prof. E. H. Pake found about eight beetles in June, one on August 4, and one on October 1, about two blocks northeast of the campus. In a nearby yard Dr. H. A. Cunningham collected two beetles side by side from a rose blossom on August 28. From September 6 to November 19 the writer operated a beetle trap in this yard, capturing two beetles by September 10. During the summer Dr. C. B. Sumner found approximately a dozen Japanese beetles on his rose bushes only a few blocks north of the original discovery in Kent. All three of these men had purchased rose bushes in the fall of 1949 from nurseries in Lake County where the beetle is common in certain areas, but the occurrence of Japanese beetles on these plants the following year may be a coincidence since none of them was packed for shipping with the original soil. The same situation was found to be true at other residences where the Japanese beetle had been found on rose bushes. The standard method of packing roots of rose bushes for shipment probably precludes the spread of grubs in that manner. However, in the immediate vicinity of several sites of beetle occurrences listed in this report, plants of one type or another had been recently introduced with their original soil. Possibly this has been one source of infestation.

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During the summer of 1951 three beetle traps were set up in the City of Kent. No. 1 was placed near the site of the original find on South Pearl St. in the western section of the city. No. 2 was placed in the yard of Dr. H. A. Cunningham in the central section, while No. 3 was placed on East Erie St., also near the central section. Between July 2 and September 23, a single specimen was captured in the first trap and another one was found on a grape vine nearby. Trap No. 2

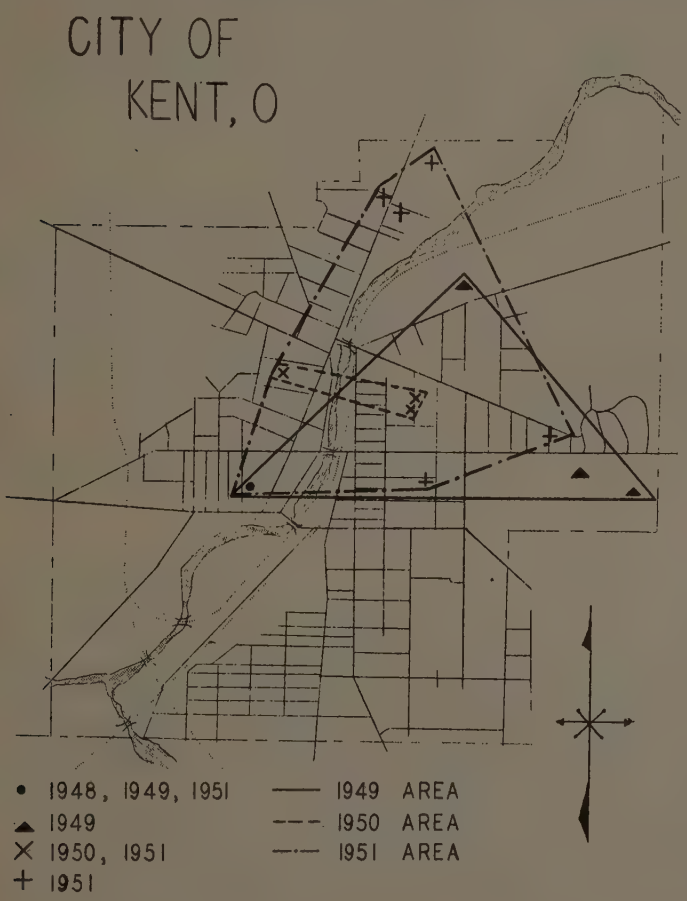

FIGURE 1. Collection sites of Japanese beetles in Kent, Ohio.

captured 13 specimens and 10 additional ones were hand picked from rose bushes at the same place. Two specimens were obtained in the third trap. Not far from trap 1 Dr. Sumner found occasional specimens on his rose bushes between July 4 and August 16. About 17 specimens in all were found and destroyed. Near trap 2 Prof. Pake collected 33 beetles from rose bushes in his yard and that of his neighbor between July 31 and August 31. His neighbor had set out rose bushes purchased near Akron. Since these were potted there is a possibility that

grubs may have been introduced in the soil. A single beetle was collected on a rose bloom in the eastern section of the city. In the north section a resident found the beetles abundantly on rose bushes. As many as 18 were counted on a single blossom in June. After the rose blooms were gone the beetles changed over to the grape vines where much damage was done to the leaves. On August 25 the writer collected 33 from a plum sapling in the same garden. Across the street Japanese beetles were reported to be numerous in several gardens and fruit trees, although only a single specimen could be found when examined by the writer on August 25. They were reported to prefer the white and yellow roses over the red varieties. The beetles were also reported in abundance on geranium plants in Standing Rock Cemetery, a block farther north, but could not be found when visited on August 25. Specimens were neither trapped nor observed anywhere after the first light frost.

Over a period of years a number of insects suspected of being the Japanese beetle have been brought by various persons to the writer and to the County Agricultural Agent, R. M. Thomas, in Ravenna. None of these specimens proved to be that species. This report includes all of the known records of this insect pest in Portage County. Infestation is still temporary and sporadic, but continued invasion and successful reproduction of those already introduced may eventually establish the insect as a permanent and common pest. Plans are being made to continue the annual survey to determine the rate and extent of spreading and to study the ecological factors concerned with its spread. Acknowledgment is made to those who reported collections of the beetles and to Dr. J. B. Polivka and Mr. R. M. Thomas for their assistance in this survey.

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Forest Entomology. *S. A. Graham.* McGraw-Hill Book Company. New York. Third Edition. 1952. xii+357 pp. $6.00.

The author has made extensive revision in this third edition of *Forest Entomology*, bringing the subject matter up-to-date, especially in the field of control measures.

Fundamentally the book deals with forest entomology and is not a volume dealing extensively with forest insects. Throughout the various chapters the author stresses the ecology of the forest and the relationship this has on insects affecting individual trees.

New chapters describe methods of forest insect surveys, covering detection and appraisal damage and the importance of legislative acts, especially Federal and State regulations.

Chemical control is treated quite thoroughly. The author warns against indiscriminate use of large-scale spraying operations. Unless chemical control operations are carefully supervised and controlled they constitute a serious threat to biotic control agencies; also chemical control can never profitably replace natural control.

The author emphasizes and demonstrates that a forest entomologist not only must know forest insects and their habits, but must also have a practical understanding of forestry and forest insect control. He should be broadly trained not only in biology and ecology, but also in silvics, silviculture, and forest management. He must also be cooperative and know how to convey his information to forest operators and others.

Chapters 1 and 2 include the introduction and historical review, while chapters 3 to 6 are chiefly ecological dealing with detection and appraisal, reproductive potential, environmental resistance, and population levels. Chapters 7 to 13 cover the various aspects of insect control. These are direct control of tree insects, direct control by chemical methods, insecticides and their effects, methods of indirect control, indirect control by parasites and predators, and indirect control by silvicultural practices. The last six chapters present information on leaf-eating insects, sap-sucking insects, meristematic insects, phloem insects, phloem-wood insects, and wood destroyers. A carefully selected bibliography and an index appear at the end.

The author is to be congratulated on the manner of presentation and for many stimulating and constructive ideas found throughout the book.

ALVAH PETERSON

BOOK NOTICES

Picture Primer of Attracting Birds. *C. Russell Mason.* Houghton Mifflin Co. Boston. First Edition. 1952. 30 pp. $2.50.

This brief guide is illustrated by the well known naturalist-illustrator, Bob Hines. The condensed text material is aimed primarily to serve as a guide for the bird-lover who wishes to plant shrubs, trees, and other flowering plants that will attract birds and give them both a home and a source of food. For the beginner it gives many helpful hints for feeding, providing natural cover, homes, and other needs of birds. A table of more desirable trees and shrubs for attracting birds will aid in planning garden plantings of shrubs and trees.

FRED H. GLENNY

Wildlife in Color. *Roger Tory Peterson.* Houghton Mifflin Co. Boston. First Edition. 1951. vi+191 pp. $3.00.

For the amateur in wildlife and nature study, and for the public school library this well illustrated book affords an interesting introduction to the biology of the out-of-doors. The author gives a brief background discussion of the present field of wildlife conservation. The following topics are then taken up: extinct native life which once inhabited North America; birds which are now in a precarious position with respect to survival; and birds which have been introduced into the United States. Most of the text is arranged according to major regions of North America, and the plant and animal life characteristic of these regions. Wildlife Miniatures, prepared over a period of twelve years for the National Wildlife Federation wildlife stamps, profusely illustrate the text. Recommended for anyone interested in wildlife, it should make a useful addition to any school library.

FRED H. GLENNY

The Physical Sciences. *E. J. Cable, R. W. Getchell and W. H. Kadesch.* Prentice-Hall, Inc. New York. Third Edition. 1951. xvii+496 pp. $5.75.

Among the relatively small number of textbooks which have been issued in the field of physical sciences, this text certainly is one of the best. The authors have struck a happy medium by not making the contents too technical, which would have put it beyond the grasp of the average college freshman, nor too elementary, which would have failed to challenge the mind of the average student.

The choice of material is excellent, and the illustrations well selected. Considering the importance of the subject, a chapter on soil conservation and conservation of natural resources would be a worthwhile addition in a future issue. It would appear more logical if the three chapters dealing with the atmosphere and weather forecasting had been included with the section dealing with geology, rather than inserting them among the chapters on physics. Although it may be a prejudice on the part of the reviewer, the double column pages did not make the reading of this text as pleasant an experience as it might have been.

NICHOLAS MOGENDORFF

Arithmetic of Pharmacy. *Charles H. Stocking and Elmon L. Cataline.* D. Van Nostrand Co., Inc. New York. Eighth Edition. 1952. xii+148 pp. $2.75.

The eighth edition of this textbook follows much the same outline of presentation as in previous editions. However, each chapter covering type problems has been condensed and clarified in presentation. Several solved typical problems are presented under each chapter's sub-heads as well as an excellent representative set to be solved by the student. The chapters on specific gravity, weight-volume, and percentage solutions (all three very important to the pharmacist) are extremely well done. Two more or less new chapters appear: one dealing with

special calculations pertaining to prescription work, and one on commercial calculations as encountered in the average pharmacy.

The volume also contains a readily usable detailed table of contents and a short appendix dealing with a rapid review of certain arithmetical procedures in which the present day college student shows pronounced weakness.

GEORGE L. BAKER

Zoogeography of the Land and Inland Waters. *L. F. de Beaufort.* Sidgwick and Jackson, Ltd. London. First Edition. 1951. viii+208 pp. $5.00 (Distributed in U. S. by Macmillan Co.)

This book deals primarily with the geographical distribution of animals and the resultant influence upon animal relationships. No sound understanding of zooecology can be obtained without first understanding something of the historical background of the land masses and their changes which have influenced, either directly or indirectly, the distribution and ultimately the evolution of animals. The present distribution of animals is viewed with respect to changes in the earth's land and water areas and the influence that they have had, along with important changes in climate, on the habitat of animals. It is highly recommended for background reading in Vertebrate Zoology and Ecology, Paleontology, and Evolution.

Every university library should have this authoritative summary of a subject of such tremendous importance in any consideration of animal relationships and distribution.

FRED H. GLENNY

Studies in Bird Migration. *H. Chr. C. Mortensen.* Ejnar Munksgaard. Copenhagen. First Edition. 1950. 272 pp. Danish Croners 18/– (paper cover), 22/– (bound).

This book is a collection of the papers of H. Chr. C. Mortensen, first of the scientific workers to apply and develop methods of bird banding to a study of bird movements and migrations. Modern methods and techniques for the study of bird migrations have stemmed from original work of this early ornithologist. Mortensen is credited with the development of the light-weight aluminum leg-band, as well as with a numbering system.

Mortensen's authentic accounts will make unusual and interesting reading to anyone interested in bird-banding and in bird migration studies. This book should certainly become a part of every college library since it is of historical as well as informational value.

FRED H. GLENNY

Mexican Birds. *George Miksch Sutton.* The University of Oklahoma Press. Norman. First Edition. 1951. xv+282 pp. $10.00.

The first part of this book is written in the easy flowing style of one accustomed to telling about his most recent adventures and travels. In this particular instance it is based upon the impressions gathered by the author during an ornithological expedition to Tamaulipas, Nuevo León, and Coahuila, Mexico. Written neither as a field-guide nor as a text-book, it combines some of their functions with a freedom of expression which make the interesting commentaries afford useful information as well as pleasant reading.

The Appendix (about one-third of the book) serves as a useful and valuable reference for ornithology students. It is recommended both as a college reference and for general reading.

FRED H. GLENNY

Up the Missouri with Audubon. *Edward Harris.* The University of Oklahoma Press. Norman. First Edition. 1951. xv+222 pp. $3.75.

The Journal of Edward Harris, close friend of James Audubon, was written during the year 1843, when a party of five men, including Mr. Audubon and Mr. Harris, made a trip up the Missouri River and into the surrounding country. This day by day account of the activities and personal observations of Mr. Harris and other members of the party also includes comments on the results of their hunting. Little known for nearly a century after its writing, the Journal is now available in its entirety due to the efforts of J. F. McDermott, who edited Harris' notes.

For those who yearn for a taste of adventure in a pioneer country, this will afford very pleasant and interesting reading.

FRED H. GLENNY

Ecological Animal Geography. *R. Hesse, W. C. Allee, & K. P. Schmidt.* John Wiley & Sons, Inc. New York. Second Edition. 1951. xiii+715 pp. $9.50.

Although many changes and additions appear in this revised edition, the text is based on Hesse's *Tiergeographie auf ökologischer Grundlage*. Many of the revisions and additions have as a basis more recent studies on the ecology and geographical distribution of animals. The text is particularly well organized into four parts: The Ecological Foundations of Zoogeography; The Distribution of Marine Animals; The Distribution of Animals in Inland Waters, a Phase of Limnology; and The Distribution of Land Animals. As the most fundamental text now available on the subject of Animal Ecology and Geographical Distribution, it should serve well as a basic college text in either General or Vertebrate Ecology courses.

FRED H. GLENNY

The Birds of Greenland, I–III. *Finn Salomonsen.* Illustrations by *Mr. Gitz-Johansen.* Einar Munksgaard. Copenhagen. First Edition. 1950. 608 pp. and map. Danish Croners: 285 –.

This three volume treatise of interest and importance should be very well received by North American ornithologists. While some of the scientific names do not correspond with those accepted by the A.O.U., it is still none the less worthy of a place in the college library as well as in any large ornithological collection. The names of the birds appear in Danish, English, Eskimo, and Latin, while the text is in both Danish and English. The author treats 69 species of birds which either breed or spend much of their time in Greenland. The distribution and occurrence of each species is clearly discussed, and other observational notes added. Fifty-two water color paintings by the artist, Mr. Gitz-Johansen, add another important feature to this publication.

FRED H. GLENNY

First Year College Chemistry. *John W. Barker* and *Paul K. Glasoe.* McGraw-Hill Book Co., New York. 1951. First Edition. x+501 pp. $5.00.

In writing this textbook the authors have tried, with marked success, to eliminate much of the material that has swelled general chemistry texts to the size of reference books. They have centered their attention mainly on fundamental concepts; and yet they have included enough collateral to provide a feeling of interest without being cumbersome.

A thorough discussion of the periodic classification of the elements is taken up early in the text. The authors also present quite soon the concept of ionization, covalency, the Bronsted Theory of acids and bases, and oxidation-reduction reactions involving the gain and loss of electrons.

Throughout the text ionic reactions are used, and where possible the reasons that reactions occur as they do are explained.

In each chapter examples and problems have been well chosen to point up important ideas to the student. In addition, an *Addenda* at the conclusion of every chapter contains information to be studied or omitted as the individual instructor or student sees fit.

In this reviewer's opinion the very nature of this text makes one feel that its full significance would be lost on classes comprised mainly of students taking one or two terms of chemistry merely to fulfill a degree requirement.

However, for classes made up of chemical engineers and chemistry majors and minors, this book may well prove its true merit. It would be an invaluable aid in presenting a good comprehensive first year course to such students.

ARTHUR H. BLACK

MEMBERSHIP IN SECTIONS OF THE OHIO ACADEMY OF SCIENCE

A.	308	I.	23
B.	211	J.	99
C.	178	K.	40
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ENROLL A NEW MEMBER

The Ohio Academy of Science was organized on December 31, 1891, at Columbus, was incorporated on March 12, 1892, and became affiliated with the American Association for the Advancement of Science early in 1920. Its membership has grown from 59 charter members to more than 1200. The membership is representative of the educational and scientific institutions of the State and includes quite a number of persons outside the State.

AIMS—According to the Constitution: "The objects of this Academy shall be the promotion of scientific research and the diffusion of knowledge concerning the various departments of science." In addition to research and publication, the Academy aids in securing legislation which is favorable to scientific projects, as conservation, topographic and geologic survey, and in other important scientific projects.

MEMBERSHIP—Membership is open to all persons interested in science. Members engaged in scientific work may be elected "fellows." Each member receives *The Ohio Journal of Science* and the publications of *The Ohio Biological Survey* for the regular annual dues of $3.00. Institution and corporation memberships are also open to such organizations in the state.

SECTIONS—Each member is enrolled in *one* section for voting purposes, but is privileged to participate in the program of any section. To avoid excessive subdivision into sections as new fields of research develop, symposia which may cut across several fields of interest are scheduled at the annual meeting at hours which permit attendance of persons from various sections. Sections are listed below.

A—Zoology	E—Psychology	I —Mathematics
B—Botany	F—Physics & Astronomy	J —Science Education
C—Geology	G—Geography	K—Anthropology & Sociology
D—Medical Sciences	H—Chemistry	L—Conservation

MEETINGS—Annual meetings are held at a time and place fixed by the Executive Committee and the Council on the basis of invitations extended by educational institutions presented at the previous annual meeting. A regional plan is followed, so all areas of the state are covered over a period of several years. In addition to the program of scientific addresses and papers, field trips are frequently arranged.

OFFICIAL ORGAN—From 1892 to 1903, the *Journal of the Cincinnati Society of Natural History* and the technical series of *Bulletins of the Ohio Experiment Station* were the official organs of the Academy; in 1903 the *Ohio Naturalist* was made the official organ and continued as such until 1915 when the *Ohio Journal of Science* became the official organ. Its columns are are open to members of the Academy for special contributions, subject to acceptance by the Editorial Board. Articles in all scientific areas appear in the *Journal*.

RESEARCH FUND—From 1898 to 1922, through the generosity of M. Emerson MacMillan, of New York, a fund was available annually for encouragement of research among the Academy members. An accumulation from this grant together with the annual grant from the A.A.A.S. makes grants for research available to Academy members. This fund is administered by a committee known as the Trustees of the Research Fund.

INFORMATION—Requests for information concerning any part of the Academy program should be addressed to the Secretary, who will either send a reply or will forward the request to the proper person for reply. The current Secretary is:

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